Technical Support Document

for the

Oklahoma and Texas Regional Haze Federal Implementation Plans
(FIP TSD)

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Oklahoma and Texas Regional Haze FIPs Technical Support Document

1 Introduction

This document provides an explanation for our proposed Federal Implementation Plans (FIPs) for the remaining portions of the Oklahoma Regional Haze SIP (OK RH SIP) that we either disapproved or did not act upon[1] in our previous action, and those portions of the Texas RH SIP for which we are proposing disapproval in this action.

2 Overview of the Gaps in the Oklahoma and Texas Regional Haze SIPs

Below, we list all of the portions of section 51.308 that we propose to disapprove for the Texas and Oklahoma RH SIPs. Please see our TX TSD and OK TSD documents for more information on why we believe these portions of the Texas and Oklahoma RH SIPs should be disapproved. We follow these sections with discussions of how we believe our FIPs fill these gaps.

2.1 Flaws in Texas' Reasonable Progress Goal, Long Term Strategy, and Other Areas

In the TX TSD, we review the Texas RH SIP and discuss our rationale for proposing to disapprove the following parts of the Texas RH SIP:

- Section 51.308(d)(1)(i)(A), regarding Texas' reasonable progress four factor analysis.
- Section 51.308(d)(1)(i)(B), regarding Texas' calculation of the emission reductions needed to achieve the URPs for the Guadalupe Mountains and Big Bend.
- Section 51.308(d)(1)(ii), regarding Texas' RPGs for the Guadalupe Mountains and Big Bend.
- Section 51.308(d)(2)(iii), regarding Texas' calculation of the natural visibility conditions for the Guadalupe Mountains and Big Bend.
- Section 51.308(d)(2)(iv)(A) regarding Texas' calculation of natural visibility impairment.
- Section 51.308(d)(3)(i) regarding Texas' long-term strategy consultation.
- Section 51.308(d)(3)(ii) regarding Texas securing its share of reductions in other States' RPGs.
- Section 51.308(d)(3)(iii) regarding Texas' technical basis for its long-term strategy.
- Section 51.308(d)(3)(v)(C), regarding Texas' emissions limitations and schedules for compliance to achieve the RPGs for Big Bend and the Guadalupe Mountains.

2.2 Flaws in Oklahoma's Flawed Reasonable Progress Goal

In the OK TSD, we do the following regarding our evaluation of the Oklahoma RH SIP:

[1] Previously, we proposed a partial approval and partial disapproval of, and a FIP for the Oklahoma SIP on March 22, 2011 (76 FR 16168). We finalized that action on December 28, 2011 (76 FR 81728).

- We review that we did not take action on whether Oklahoma satisfied the RP requirements of section 51.308(d)(1) in our previous action, because we concluded we must first evaluate and act upon the RH SIP revision submitted by Texas.
- Having now reviewed the Texas RH SIP, we review Oklahoma's submittal for satisfying the RP requirements of section 51.308(d)(1).
- We discuss our rationale for proposing to disapprove the RPGs for the Wichita Mountains set by Oklahoma in its regional haze SIP. In setting its RPG, we propose to find that Oklahoma generally did not meet the requirements of Section 51.308(d)(1) of the Oklahoma regional haze SIP, except for Section 51.308(d)(1)(vi).

3 Our FIPs Cure Defects in the Texas and Oklahoma Regional Haze SIPs

Below we discuss why we believe our FIPs provide the information necessary to cure the defects in the Oklahoma and Texas RH SIPs that we have outlined above.

3.1 Summary of the Texas FIP

We believe our proposed FIP and its rationale as presented here provide the technical analysis that was lacking in Texas' development of its RPGs for the Guadalupe Mountains and Big Bend, and in its consultations with Oklahoma for the development of the RPGs for the Wichita Mountains, as well as addressing its long-term strategy. As Texas did in the development of its SIP, we have also used the same analysis to address both tasks. We began our review of Texas' conclusions with an initial analysis of all point sources in Texas and an assessment of the visibility impact from those sources with the greatest potential to contribute to visibility impairment. A refinement of this analysis resulted in our focus on a much smaller group of sources that essentially reduced down to an analysis of whether, in light of the balance between the cost of control and visibility benefits of control at each source, additional SO_2 controls should be installed on each of certain large coal fired EGUs in Texas in order to improve the visibility at these Class I areas. We conducted our analysis using the four reasonable progress factors listed in Section 51.308(d)(1)(i)(A). We propose to find that this portion of our proposed Texas FIP would make whole our disapproval of those portions of the Texas SIP intended to meet:

- Section 51.308(d)(1)(i)(A).
- Section 51.308(d)(3)(i).
- Section 51.308(d)(3)(ii).
- Section 51.308(d)(3)(iii).
- Section 51.308(d)(3)(v)(C).

We also establish the natural visibility conditions for the Guadalupe Mountains and Big Bend. We then use those values and the analysis we have developed above to consider the emission reductions needed to achieve the URPs for the Guadalupe Mountains and Big Bend and establish their RPGs. We propose that these portions of our Texas FIP, developed below, make whole our disapproval of those portions of the Texas SIP intended to meet:

- Section 51.308(d)(2)(iii).
- Section 51.308(d)(2)(iv)(A).

- Section 51.308(d)(1)(i)(B).
- Section 51.308(d)(1)(ii).

3.2 Summary of the Oklahoma FIP

We believe some of the same portions of our proposed Texas FIP would also make whole the portions of the Oklahoma regional haze SIP we propose to disapprove. We believe that Oklahoma's flawed consultation with Texas denied it the knowledge it needed—the visibility impacts of individual sources in Texas with the largest potential to impact the visibility at the Wichita Mountains and the extent to which cost-effective controls were available—in order to properly construct its RPG for the Wichita Mountains. As indicated in the record, both the ODEQ and the TCEQ acknowledged during the development of their respective regional haze SIPs that Texas point sources have a significant visibility impact at the Wichita Mountains and that cost-effective controls were likely available for these sources. Armed with this knowledge, however, the ODEQ did not pursue the point in its consultations with the TCEQ under Section 51.308(d)(1)(iv). We believe that our proposed OK FIP would make whole the requirement in the Regional Haze Rule for states to adequately consult and to provide the information we believe should have resulted from those consultations. We propose that our analysis of potential controls for Texas sources allows us to reset Oklahoma's RPG and demonstrate it is reasonable.

4 Technical Overview of the Oklahoma and Texas FIPs

As discussed in Appendix A to this TSD, we have determined that based on their visibility impacts, a smaller subset of the facilities that we have initially analyzed should be further evaluated to determine (1) if cost effective controls are available and (2) considering their projected visibility benefits, which, if any controls should be proposed. With one exception, the PPG Flat Glass plant in Wichita Falls, all of the facilities are coal fired power plants. Also as discussed in that section, we are limiting our analyses to the consideration of SO_2 controls for these EGU sources, as our modeling indicates that the impacts from these sources on the 20% worst days are primarily due to sulfate emissions. In our Cost TSD, we conduct a SO_2 cost analyses for the following facilities and units:

Table 1. Sources undergoing RP and LTS analyses

Facility	**Units**	**Scrubbed?**	**Bypass?**
Big Brown	1, 2		
Sandow 4	1	Y	Y
Monticello	1, 2		
Monticello	3	Y	Y
Martin Lake	1, 2, 3	Y	Y
Coleto Creek	1		
Limestone	1, 2	Y	Y
San Miguel	1	Y	N
Tolk	1, 2		
Welsh	1, 2, 3		
W. A. Parish	5, 6, 7		
W. A. Parish	8	Y	Y

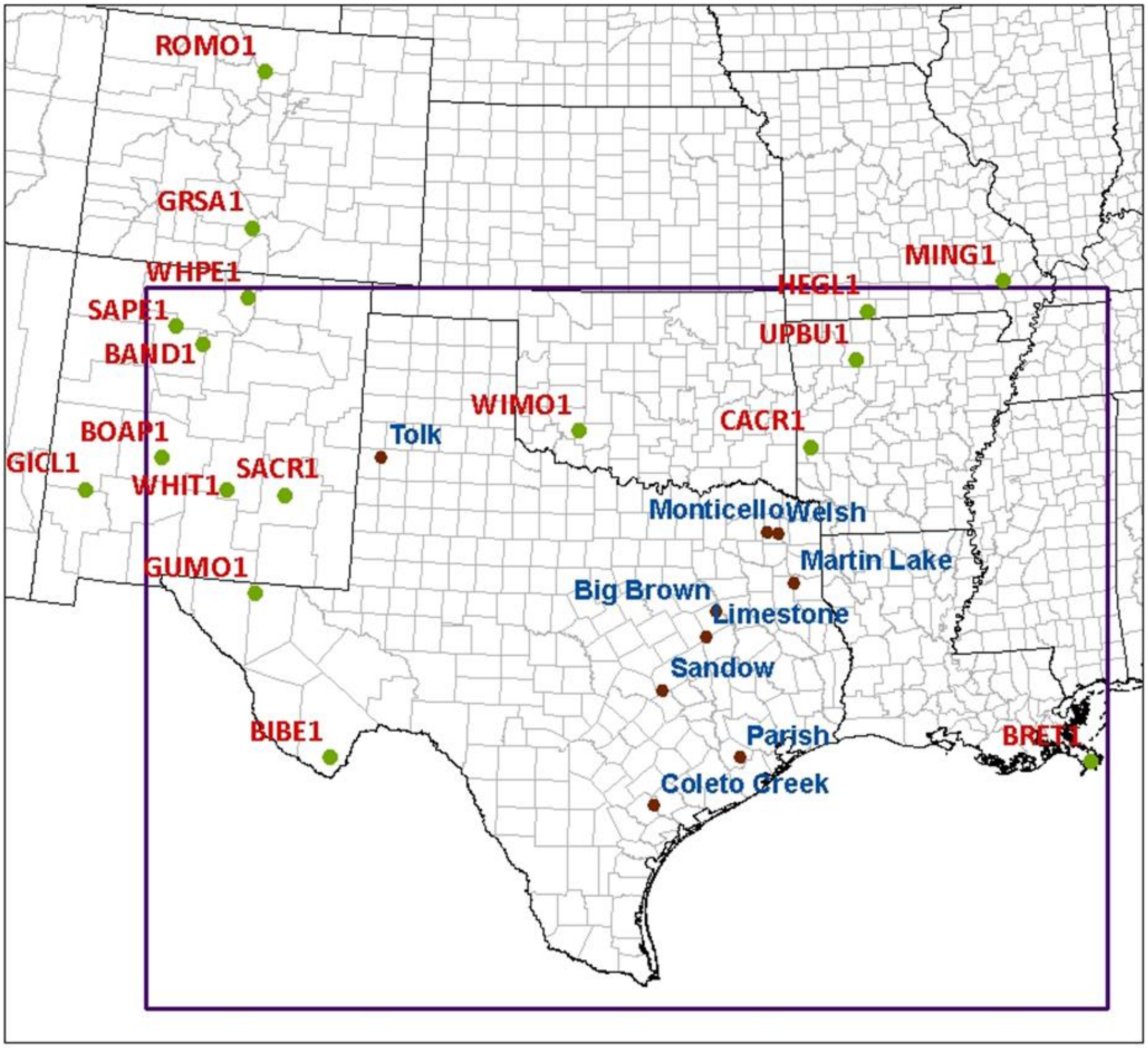
In addition to these sources, we have examined the PPG Flat Glass Plant in Wichita Falls, Texas. This is the only non-EGU and the only source for which NOx controls are considered. For all of the sources we examined, visibility impacts were dominated by the impacts from SO_2 emissions with the exception of the PPG Flat Glass Plant. Because of the proximity of this facility to Wichita Mountains, NOx and SO_2 emissions from the facility were both responsible for the visibility impacts at Wichita Mountains. As discussed in more detail below, we evaluated these impacts and considered recent emissions and permit data in considering the potential need for additional controls for this facility.

4.1 Location of Sources

The following is a map of Texas and the surrounding states that shows, with the exception of San Miguel,[2] the locations of the sources listed in Table 1 and selected Class I areas.

[2] For reasons we discuss elsewhere in this document, we are not proposing any additional controls on San Miguel.

Figure 1 – Map of sources and Class I areas



In the above map, the Wichita Mountains, Big Bend, and the Guadalupe Class I areas are abbreviated by WIMO1, BIBE1, GUMO1, respectively. These are the Class I areas most often referenced in our analysis.

4.2 Approach to Reasonable Progress and Long term Strategy

We are simultaneously conducting reasonable progress and long-term strategy analyses. These analyses address both (1) the requirements to consider the four reasonable progress factors for the Texas Class I areas, and (2) the technical basis required to develop the long-term strategy for the Texas Class I areas and the Wichita Mountains in Oklahoma. We use the "four factor analysis" method outlined in 40 CFR 51.308(d)(1)(A) that States are directed to use in establishing a RPG:

> (1) Reasonable progress goals. For each mandatory Class I Federal area located within the State, the State must establish goals (expressed in deciviews) that provide for reasonable progress towards achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for the most impaired days over the period of the implementation plan and ensure no degradation in visibility for the least impaired days over the same period.
>
> (i) In establishing a reasonable progress goal for any mandatory Class I Federal area within the State, the State must:
>
> (A) **Consider the costs of compliance, the time necessary for compliance, the energy and non-air quality ENVIRONmental impacts of compliance, and the remaining useful life of any potentially affected sources**, and include a demonstration showing how these factors were taken into consideration in selecting the goal.

To assist in interpreting these reasonable progress factors, we will rely on our reasonable progress Guidance.[3] Our Reasonable Progress Guidance notes the similarity between some of the reasonable progress factors and the BART factors contained in Section 51.308(e)(1)((ii)(A), and suggests that the BART Guidelines be consulted regarding cost, energy and non-air quality environmental impacts, and remaining useful life. We are therefore relying on our BART Guidelines for assistance in interpreting those reasonable progress factors, as applicable.

We note that with one exception,[4] the issues relating to the evaluation of three of these factors: (1) time necessary for compliance, (2) energy and non-air quality environmental impacts of compliance, and (3) remaining useful life, are common to all the units we are analyzing. Thus, we are analyzing these factors for all the units simultaneously.

In analyzing the remaining factor, cost of compliance, we are including in our evaluation a consideration of any control technology that may already be installed at the facility. Also, similar to a BART analysis, we are also considering the projected visibility benefit in our analysis. As we state in our Arizona proposal[5]:

> While visibility is not an explicitly listed factor to consider when determining whether additional controls are reasonable, the purpose of the four-factor analysis is to determine what degree of progress toward natural visibility conditions is reasonable. Therefore, it is appropriate to consider the projected visibility benefit of the controls when determining if the controls are needed to make reasonable progress.

For each unit, we are weighing the cost of compliance against the projected visibility benefit in a cost/benefit analysis.

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[3] Guidance for Setting Reasonable Progress Goals Under the Regional Haze Program, June 1, 2007.

[4] For reasons we discuss below, we believe that the Tolk facility may merit a special consideration of the energy and non-air quality environmental impacts of compliance.

[5] See 79 FR 9353, footnote 137. We also finalized our proposal in 79 FR 52420, using this same reasoning.

4.2.1 Time Necessary for Compliance, and the Oklahoma and Texas RPGs

We discuss the time necessary for compliance reasonable progress factor in our Reasonable Progress Guidance:[6]

> It may be appropriate for you to use this factor to adjust the RPG to reflect the degree of improvement in visibility achievable within the period of the first SIP if the time needed for full implementation of a control measure (or measures) will extend beyond 2018. For example, if you anticipate that constraints on the availability of construction labor will preclude the installation of controls at all sources of a particular category by 2018, the visibility improvement anticipated from installation of controls at the percentage of sources that could be controlled within the strategy period should be considered in setting the RPG and in establishing the SIP requirements to meet the RPG.

Due to delays in processing the Texas regional haze SIP and the remaining portion of the Oklahoma regional haze SIP, we cannot assume that the SO_2 controls we are proposing will be installed and operational within this planning period, which ends in 2018. For instance, typical SO_2 scrubber installations can take up to five years to plan, construct and bring to operational readiness. This would mean that any such controls that we may require in our final action may not be operational until after 2018. Therefore, although we are proposing revised RPGs for Oklahoma and Texas, we are proposing RPGs that only account for the scrubber upgrades included in this FIP anticipated to be completed by 2018. We request that Oklahoma and Texas consider the additional visibility improvements anticipated from any proposed FIP controls implemented after 2018 with the submission of their next regional haze SIPs due July 13, 2018.

4.2.2 Energy and Non-Air Quality Environmental Impacts of Compliance

Regarding the analysis of energy impacts, the BART Guidelines advise, "You should examine the energy requirements of the control technology and determine whether the use of that technology results in energy penalties or benefits."[7] As discussed below in our cost analyses for Dry Sorbent Injection (DSI) and Spray Dryer Absorber (SDA) SO_2 scrubbers, our cost model allows for the inclusion or exclusion of the cost of the additional auxiliary power required for the pollution controls we considered to be included in the variable operating costs. We chose to include this additional auxiliary power in all cases. Consequently, we believe that any energy impacts of compliance have been adequately considered in our analyses.
Regarding the analysis of non-air quality environmental impacts, the BART Guidelines advise[8]:

> Such environmental impacts include solid or hazardous waste generation and discharges of polluted water from a control device. You should identify any significant or unusual environmental impacts associated with a control alternative that have the potential to affect the selection or elimination of a control

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[6] Guidance for Setting Reasonable Progress Goals Under the Regional Haze Program, June 1, 2007. Page 19.
[7] 70 FR 39168 (July 6, 2005).
[8] 70 FR 39169 (July 6, 2005).

> alternative. Some control technologies may have potentially significant secondary environmental impacts. Scrubber effluent, for example, may affect water quality and land use. Alternatively, water availability may affect the feasibility and costs of wet scrubbers. Other examples of secondary environmental impacts could include hazardous waste discharges, such as spent catalysts or contaminated carbon. Generally, these types of environmental concerns become important when sensitive site-specific receptors exist or when the incremental emissions reductions potential of the more stringent control is only marginally greater than the next most-effective option. However, the fact that a control device creates liquid and solid waste that must be disposed of does not necessarily argue against selection of that technology as BART, particularly if the control device has been applied to similar facilities elsewhere and the solid or liquid waste is similar to those other applications. On the other hand, where you or the source owner can show that unusual circumstances at the proposed facility create greater problems than experienced elsewhere, this may provide a basis for the elimination of that control alternative as BART.

The SO_2 control technologies we considered in our analysis – DSI and scrubbers – are in wide use in the coal-fired electricity generation industry. Both technologies add spent reagent to the waste stream already generated by the facilities we analyzed, but do not present any unusual environmental impacts. As discussed below in our cost analyses for DSI and SDA SO_2 scrubbers, our cost model includes waste disposal costs in the variable operating costs. Consequently, we believe that with one possible exception, any non-air quality environmental impacts have been adequately considered in our analyses. An examination of the aerial photo of the Tolk facility, which we present in section 5.4, does not reveal any obvious source of surface water. We therefore assume that well water is used. In light of this and its potential relationship to the energy and non-air quality environmental impacts of compliance, we limit our SO_2 control analysis for Tolk to DSI and dry scrubbers.

4.2.3 Remaining Useful Life

Regarding the analysis of the remaining useful life, the BART Guidelines advise:

> The ''remaining useful life'' of a source, if it represents a relatively short time period, may affect the annualized costs of retrofit controls. For example, the methods for calculating annualized costs in EPA's OAQPS Control Cost Manual require the use of a specified time period for amortization that varies based upon the type of control. If the remaining useful life will clearly exceed this time period, the remaining useful life has essentially no effect on control costs and on the BART determination process. Where the remaining useful life is less than the time period for amortizing costs, you should use this shorter time period in your cost calculations.

In determining the cost of scrubbers in our prior Oklahoma FIP, we used a lifetime of 30 years. In so doing, we noted[9] that scrubber vendors indicate that the lifetime of a scrubber is equal to the lifetime of the boiler, which might easily be over 60 years. We also noted that many scrubbers that were installed between 1975 and 1986 are still in operation today (e.g., Coyote Station, H.L. Spurlock Unit 2, East Bend Unit 2, Laramie River Unit 3, Cholla 5, Basin Electric, Mitchell Unit 33, and all of the units in Table 30 that currently have scrubbers). Further, we noted that standard cost estimating handbooks and published papers report 30 years as a typical life for a scrubber and that many utilities routinely specify 30+ year lifetimes in requests for proposal and to evaluate proposals. We have used this 30 year lifetime approach in prior actions and we therefore adopted the same scrubber lifetime in our present analysis. See 76 FR 52388 (Aug 22, 2011); 76 FR 81728 (Dec. 28, 2011); Oklahoma v. EPA, 723 F.3d 1201 (July 19, 2013), *cert. denied* (U.S. May 27, 2014).

We see no reason to assume that a DSI system installation, which is a much less complex and costly (capital costs, as opposed to annualized costs) technology in comparison to a scrubber installation, should have a shorter lifetime. As with a scrubber, we expect the boiler to be the limiting factor when considering the lifetime of a coal-fired power plant. We have therefore similarly assumed that the lifetime of a DSI system is 30 years, as constrained by the boiler lifetime, as noted above.

The BART Guidelines provide further clarification:

> Where this affects the BART determination, this date should be assured by a federally- or State-enforceable restriction preventing further operation. We recognize that there may be situations where a source operator intends to shut down a source by a given date, but wishes to retain the flexibility to continue operating beyond that date in the event, for example, that market conditions change. Where this is the case, your BART analysis may account for this, but it must maintain consistency with the statutory requirement to install BART within 5 years. Where the source chooses not to accept a federally enforceable condition requiring the source to shut down by a given date, it is necessary to determine whether a reduced time period for the remaining useful life changes the level of controls that would have been required as BART.

As in a BART determination, we propose to adopt the same requirement regarding the need for a federally enforceable restriction for any DSI or scrubber remaining useful life of less than 30 years.

4.3 Analysis of the PPG Flat Glass Plant

The Wichita Falls PPG flat glass plant is located in Wichita Falls, Texas. The plant began operations in 1974.[10] The facility produces flat glass on two production lines, each with its own

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[9] Technical Support Document for the Oklahoma Regional Haze State Implementation Plan and Federal Implementation Plan. March 2011, p. 14.
[10] http://corporate.ppg.com/Our-Company/Worldwide-Operations/North-America/Wichita-Falls

natural gas furnace. A furnace typically lasts ten to twelve years until re-bricking is required. In 2007, PPG applied to the TCEQ for a standard permit registration[11] in order to obtain authorization for the implementation of a low-NOx oxy-fuel injection conversion to its Melting Furnace No. 1. As a result of this upgrade, PPG calculated its NOx emissions from Furnace No. 1 would decrease by approximately 1,996 tpy to 894.25 tpy. PPG also further reduced their NOx emissions as a result of a fuel conservation project which occurred with the rebuilding of Furnace No. 2. This project lowered the NOx emissions of Furnace No. 2 from an allowable annual NOx limit of 3,236.82 tpy to 2,947.49 tpy. These reductions were incorporated into a permit alteration.[12]

Table 31 below compares the 2018 projected CENRAP emission inventory to the 2002 CENRAP emission inventory, the current permit limits for the two furnaces, and average actual annual emissions for the facility. We projected the visibility impact from this facility at the 2018 projected emission level to be 0.635 Mm^{-1} at Wichita Mountains (using source apportionment). Permit allowable emissions for NOx for the two furnaces are much lower than projected and modeled for 2018 and lower than the 2002 emission level. The 2018 projected emissions for SO_2 also exceed the permitted emissions for furnace No. 2. Average annual emissions are only 44% of the projected 2018 emissions for NOx and 81% of the projected SO_2 emissions. Therefore, we estimate that the current visibility impact due to the facility is significantly lower than the 2018 projected value. We are proposing to find that the Wichita Falls PPG flat glass plant is adequately controlled to address visibility impacts from this facility for the first planning period. We encourage the State of Texas to revisit this issue when Furnace No. 2 is scheduled for its next re-bricking

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[11] Standard Permit Registration, PPG Industries, Inc., Wichita Falls Plant, Account No. WH-0040-R. Submitted by ENVIRON, dated October 11, 2007.

[12] Permit Alteration, Permit Number: 898, Flat Glass Manufacturing Facility, Wichita Falls, Wichita County, Regulated Entity Number: RN102522950, Customer Reference Number: CN600124614, Account Number: WH-0040-R

Table 31. Emission comparison for PPG Flat Glass Plant

	CENRAP 2002 emission inventory (tpy)		CENRAP 2018 emission inventory (tpy)		Permit Allowable[13] (tpy)		Average Annual Emissions (tpy, 2009-2012)[14]	
	NOx	SO_2	NOx	SO_2	NOx	SO_2	NOx	SO_2
Furnace No. 1	2,694.5	48.0	4,526.8	80.7	894.3	180.3	---	---
Furnace No. 2	2,495.2	279.7	4,191.9	470.0	2,947.5	350.4	---	---
Furnace No. 1 and No. 2	5,189.7	327.7	8,718.8	550.6	3,841.7	530.7	---	---
Facility total	5,317.0	371.0	8,929.0	623.0	---	---	3,887.8	501.9

4.4 Approach to Technical Analysis

We present a reasonable progress and long term strategy cost analyses for those units being analyzed for DSI or scrubber retrofits in which we assess the cost of DSI, SDA, and wet FGD. The modeled benefits that would result from the installation of those controls are reviewed, and the cost of the controls are weighed against their projected visibility benefits at a number of Class I areas. We then propose which units should install SO_2 control equipment and the control level those units should achieve. Please see our Cost TSD for more detail on how we performed the cost analysis and Appendix A to this TSD for more details about how we conducted our visibility analysis.

We also present a summary of our scrubber upgrade cost analyses for those units in Table 1 that are already partially scrubbed. We present a similar cost/benefit analysis as we did for each unit we analyzed for scrubber upgrades. We propose which units should install SO_2 scrubber upgrades and the control level those units should achieve.

4.5 Use of Confidential Business Information

Within our Cost TSD, we calculate the SO_2 removal efficiencies for the underperforming scrubbers listed in Table 1, and present information that discusses how these scrubbers have been historically upgraded and what kinds of equipment revisions are typically required. In order to assess the potential range of options available to upgrade the scrubbers in the facilities listed in Table 30, we must have an understanding of what upgrades may have already been performed. Because most of this information is not available publicly, we have requested it under authority

[13] Permit Alteration, Permit Number: 898, Flat Glass Manufacturing Facility, Wichita Falls, Wichita County, Regulated Entity Number: RN102522950, Customer Reference Number: CN600124614, Account Number: WH-0040-R

[14] TCEQ point source emission inventory. Downloaded from https://www.tceq.texas.gov/airquality/point-source-ei/psei.html and available in the docket for this action.

granted to us under Section 114(a) of the CAA. For each unit, we then conducted a cost analysis for eliminating any scrubber bypass and upgrading the units' overall SO_2 removal efficiency to at least 95%. As most of the information we received in response to our Section 114(a) requests was claimed as Confidential Business Information (CBI) under 40 C.F.R. Part 2, Subpart B, therefore we are limited in what we are able to publicly state in this analyses. Consequently, although our full cost analysis is available on a facility-by-facility basis for viewing by the companies who provided us with the CBI material, we can only provide a summary of it below.

5 Reasonable Progress and Long Term Strategy Scrubber and DSI Cost Analyses

In Section 4, above, we discuss how we are simultaneously conducting RP and LTS analyses using the "four factor analysis" outlined in 40 CFR 51.308(d)(1)(A) that states are directed to use in establishing a RPG. We also discuss why we are considering visibility in our analysis. We considered the costs of compliance for DSI, SDA and wet FGD, the time necessary for compliance, the energy and non-air quality environmental impacts of compliance, and the remaining useful life of any potentially affected sources.

In this section, for each unit with no SO_2 control, we provide an overview of the facility based on data from our Air Markets Program Data website,[15] and reporting to the EIA via Forms 860 and 923. We develop our cost estimates for DSI, SDA, and wet FGD in our COST TSD. Here, we present the historical annual emissions,[16] and contrast the cost of DSI, SDA, and wet FGD.

As we discuss in Our Cost TSD, we evaluated each unit at its maximum recommended level of control, considering the type of SO_2 control device:

- We evaluated each unit at its maximum recommended DSI performance level, according to the IPM DSI documentation, assuming milled trona: 80% SO_2 removal for an ESP installation and 90% SO_2 removal for a baghouse installation. This level of control is within that of SO_2 scrubbers, and thus allows a better comparison of the costs of DSI and scrubbers.
- However, as we state above, we believe that the maximum performance level for DSI can only be determined after an onsite performance test. Therefore, we don't know whether a given unit is actually capable of achieving these DSI control levels, and (2) we believe it is useful to evaluate lesser levels of DSI control (and correspondingly lower costs). We therefore also evaluated all the units at a DSI SO_2 control level of 50%, which we believe is likely achievable for any unit.
- The SDA level of control was assumed to be either a maximum of 95% not to go below 0.06 lbs/MMBtu.
- The wet FGD level of control was assumed to be a maximum of 98% not to go below 0.04 lbs/MMBtu.

As we note in our Cost TSD, the cost effectiveness of DSI worsens (increasing $/ton) as the level of control goes up. For all but one of the units we analyzed, even at the lower level of control of 50%, the cost effectiveness of DSI was worse than either SDA or wet FGD, even with the latter

15 http://ampd.epa.gov/ampd/
16 Ibid.

options offering much greater levels of control. At the higher 80% or 90% level of control, the cost effectiveness of DSI was worse than either SDA or a wet FGD in all cases.

5.1 Big Brown Units 1 and 2

The Big Brown facility is located in Fairfield, within Freestone County, Texas. It is comprised of two coal fired units. Unit 1, a tangentially-fired boiler rated at 572.9 MW, became operational in 1971 and Unit 2, also a tangentially-fired boiler rated at 572.9 MW, became operational in 1972. Both units burn a mixture of Texas lignite and PRB coal. Neither unit has any SO_2 control. Both units employ Low NOx Burners (LNB), Separated Overfire Air (SOFA), and Selective Non-Catalytic Reduction (SNCR) to control NOx. Both units also employ cold side ESPs (downstream of the air pre-heaters) and baghouses to control PM. Both units employ Activated Carbon Injection (ACI) to control mercury.

Figure 2. Aerial view of the Big Brown facility

5.1.1 Emissions Summary

Below are the annual SO_2 for Big Brown Units 1 and 2:

Table 3. Annual SO_2 and NOx emissions for Big Brown Units 1 and 2

Facility	Unit	Year	SO_2 (tons)
Big Brown	1	2009	28,929
		2010	31,131
		2011	30,070
		2012	32,100
		2013	30,801
1	2	2009	26,619
		2010	32,169
		2011	34,127
		2012	28,581
		2013	31,693

5.1.2 Analysis of the Cost of Compliance

Below we summarize and contrasts the costs for installing DSI, SDA, and wet FGD:

Table 4. Contrast in SO_2 control cost effectiveness

Facility	Unit	Control	Control level (%)	SO_2 reduction (tpy)	$/ton reduced
Big Brown	1	DSI	50.0	15,334	$2,223
		DSI	90.0	27,600	$2,996
		SDA	95.0	29,134	$1,377
		Wet FGD	98.0	30,054	$1255
	2	DSI	50.0	15,407	$2,201
		DSI	90.0	27,733	$2,994
		SDA	95.0	29,273	$1,373
		Wet FGD	97.9	30,169	$1,257

5.2 Monticello Units 1 and 2

The Monticello facility is located in Mount Pleasant, within Titus County, Texas. It is comprised of three coal fired units. Units 1 and 2 do not have any SO_2 control and are treated in this section, and Unit 3 is partially scrubbed for SO_2 and is treated in section 4. Unit 1, a tangentially-fired boiler rated at 562.9 MW, became operational in 1974, and Unit 2, also a tangentially-fired boiler rated at 562.9 MW, became operational in 1975. Both units burn a mixture of Texas lignite and PRB coal. Units 1 and 2 employ LNB with SOFA and SNCR. Both units also employ cold side ESPs to control PM. Baghouses were installed in 1978-80 on Units 1 and 2 to accommodate 80% of the flow as the ESPs were not effective at controlling PM emissions.[17] All three units employ Activated Carbon Injection (ACI) to control mercury.

Figure 3. Aerial view of the Monticello facility

[17] Larry G. Felix, Randy L. Merritt, and Kkent Duncan, Improving Baghouse Performance at the Monticello Generating Station, Journal of the Air Pollution Control Association, v. 36, no. 9, September 1986, pp. 1075 – 1085.

5.2.1 Emissions Summary

Below are the annual SO_2 for Monticello Units 1 and 2:

Table 5. Annual SO_2 and NOx emissions for Big Brown Units 1 and 2

Facility	Unit	Year	SO_2 (tons)
Monticello	1	2009	20,509
		2010	19,160
		2011	21,897
		2012	13,925
		2013	6,683
1	2	2009	20,930
		2010	19,872
		2011	18,436
		2012	10,980
		2013	7,072

5.2.2 Analysis of the Cost of Compliance

Below we summarize and contrasts the costs for installing DSI, SDA, and wet FGD:

Table 6. Contrast in SO_2 control cost effectiveness

Facility	Unit	Control	Control level (%)	SO_2 reduction (tpy)	$/ton reduced
Monticello	1	DSI	50.0	8,933	$2,728
		DSI	90.0	16,079	$3,420
		SDA	95.0	16,972	$2,012
		Wet FGD	97.0	17,328	$1,937
	2	DSI	50.0	8,215	$3,086
		DSI	90.0	14,786	$3,845
		SDA	95.0	15,608	$2,254
		Wet FGD	96.8	15,907	$2,170

5.3 Coleto Creek

The Coleto Creek facility is located near Fannin, within Goliad County, Texas. It is comprised of a single coal fired unit. The Coleto Creek facility has one unit, a tangentially-fired boiler rated at 629.5 MW which became operational in 1980. It burns PRB coal and does not have any SO_2 control. It employs LNB with OFA to control NOx and a baghouse to control PM.

Figure 4. Aerial view of the Coleto Creek facility

5.3.1 Emissions Summary

Below are the annual SO_2 emissions for Coleto Creek:

Table 7. Annual SO_2 and NOx emissions for Coleto Creek

Facility	Unit	Year	SO_2 (tons)
Coleto Creek	1	2009	21,453
		2010	17,616
		2011	13,694
		2012	16,218
		2013	14,344

5.3.2 Analysis of the Cost of Compliance

Below we summarize and contrasts the costs for installing DSI, SDA, and wet FGD:

Table 8. Contrast in SO_2 control cost effectiveness

Facility	Unit	Control	Control level (%)	SO_2 reduction (tpy)	$/ton reduced
Coleto Creek	1	DSI	50.0	8,030	$2,792
		DSI	90.0	14,453	$3,460
		SDA	93.5	15,012	$2,356
		Wet FGD	95.7	15,361	$2,278

5.4 Tolk Units 171B and 172B

The Tolk facility is located on County Road 65 between Earth and Muleshoe, within Lamb County, Texas. It is comprised of two coal fired units. Unit 171B, a tangentially-fired boiler rated at 533 MW, became operational in 1982 and Unit 172B, also a tangentially-fired boiler rated at 542.9 MW, became operational in 1985. Both units burn PRB coal. Neither unit has any SO_2 control. Both units employ OFA to control NOx. Both units also employ baghouses to control PM. An aerial photo of the Tolk facility is shown below. Expanding the view of this photo does not reveal any obvious source of surface water. We therefore assume that well water is used. In light of this and its potential relationship to the energy and non-air quality environmental impacts of compliance, we limit our SO_2 control analysis for Tolk to DSI and dry scrubbers.

Figure 5. Aerial view of the Tolk Facility

5.4.1 Emissions Summary

Below are the annual SO_2 emissions for Tolk Units 171B and 172B.

Table 9. Annual SO_2 and NOx emissions for Tolk Units 171B and 172B

Facility	Unit	Year	SO_2 (tons)
Tolk	171B	2009	10,681
		2010	12,412
		2011	10,546
		2012	8,613
		2013	8,868
	172B	2009	11,960
		2010	12,062
		2011	9,285
		2012	10,555
		2013	10,586

5.4.2 Analysis of the Cost of Compliance

Below we summarize and contrasts the costs for installing DSI, SDA, and wet FGD:

Table 10. Contrast in SO_2 control cost effectiveness

Facility	Unit	Control	Control level (%)	SO_2 reduction (tpy)	$/ton reduced
Tolk	171B	DSI	50.0	5,016	$3,084
		DSI	90.0	9,028	$3,592
		SDA	91.7	9,195	$3,178
		Wet FGD	94.4	9,474	$3,204
	172B	DSI	50.0	5,517	$2,828
		DSI	90.0	9,931	$3,221
		SDA	90.8	10,015	$2,998
		Wet FGD	93.8	10,355	$3,019

5.5 Welsh Units 1, 2, and 3

The Welsh facility is located southeast of Mount Pleasant, within Titus County, Texas. It is comprised of three coal fired units. All three units are wall fired boilers. Unit 1 is rated at 521.6 MW and became operational in 1977, Unit 2 is rated at 519 MW and became operational in 1980, and Unit 3 is rated at 519 MW and became operational in 1982. All three units burn PRB coal. None of the units have any SO_2 control, and all three units employ LNB with OFA to control NOx, and hot side ESPs to control PM. Unit 2 is scheduled to retire no later than December 31, 2016.[18]

Figure 6. Aerial view of the Welsh facility

[18] See Sierra Club et al v. U.S. Army Corps of Engineers, civil 4:10-cv-04017-RGK, also letter from John M. McManus to Mike Wilson, dated May 2, 2013. Under the terms of a consent decree, after the Turk Plant commences commercial operation, Unit 2 will be restricted to a 60% annual capacity factor during any rolling 12-month period. Thereafter, Unit 2 must be retired no later than December 31, 2016.

5.5.1 Emissions Summary

Below are the annual SO_2 emissions for Welsh Units 1, 2, and 3.

Table 11. Annual SO_2 and NOx emissions for Welsh Units 1, 2, and 3

Facility	Unit	Year	SO_2 (tons)
Welsh	1	2009	9,061
		2010	8,361
		2011	8,401
		2012	7,491
		2013	6,469
	2	2009	9,453
		2010	8,792
		2011	8,386
		2012	7,588
		2013	6,159
	3	2009	8,858
		2010	9,534
		2011	8,836
		2012	8,133
		2013	7,092

5.5.2 Analysis of the Cost of Compliance

Below we summarize and contrasts the costs for installing DSI, SDA, and wet FGD:

Table 12. Contrast in SO_2 control cost effectiveness

Facility	Unit	Control	Control level (%)	SO_2 reduction (tpy)	$/ton reduced
Welsh	1	DSI	50.0	4,042	$3,718
		DSI	80.0	6,467	$4,019
		SDA	88.7	7,169	$3,489
		Wet FGD	92.5	7,474	$3,508
	2	DSI	50.0	4,128	$3,611
		DSI	80.0	6,605	$3,879
		SDA	88.2	7,285	$3,438
		Wet FGD	92.2	7,608	$3,454
	3	DSI	50.0	4,305	$3,690
		DSI	80.0	6,887	$3,998
		SDA	88.7	7,634	$3,368
		Wet FGD	92.5	7,959	$3,379

5.6 W. A. Parish Units WAP5, WAP6, and WAP7

The W. A. Parish facility is often cited as being the largest electricity generating facility in the U.S.[19] It is located southeast of Houston, within Fort Bend County, Texas. It is comprised of nine units. Units 5, 6, 7, and 8 are coal fired but burn a small amount of natural gas. Units 5, 6, and 7 do not have any SO_2 control and are treated in this section. Unit 8, which is partially scrubbed for SO_2 is treated in Section 4. Unit 5 is a wall fired boiler that became operational in 1977 and is rated at 638.7 MW. Unit 6 is also a wall fired boiler that became operational in 1978 and is rated at 636.8 MW. Unit 7 is a tangentially fired boiler that became operational in 1980 and is rated at 559.4 MW. All three units employ Selective Catalytic Reduction (SCR) to control NOx and baghouses to control PM.

Figure 7. Aerial view of the W. A. Parish facility

19 https://online.platts.com/PPS/P=m&s=1029337384756.1478827&e=1092414376630.634056602174080316/?artnum=200vh40u811t1F30702VSa_1

5.6.1 Emissions Summary

Below are the annual SO_2 emissions for W. A. Parish Units WAP5, WAP6, and WAP7.

Table 13. Annual SO_2 and NOx emissions for W. A. Parish Units WAP5, WAP6, and WAP7

Facility	Unit	Year	SO_2 (tons)
W. A. Parish	WAP5	2009	14,145
		2010	16,232
		2011	14,992
		2012	12,774
		2013	13,335
	WAP6	2009	13,206
		2010	17,149
		2011	18,267
		2012	12,695
		2013	15,565
	WAP7	2009	12,492
		2010	13,200
		2011	13,147
		2012	10,391
		2013	11,365

5.6.2 Analysis of the Cost of Compliance

Below we summarize and contrasts the costs for installing DSI, SDA, and wet FGD:

Table 14. Contrast in SO_2 control cost effectiveness

Facility	Unit	Control	Control level (%)	SO_2 reduction (tpy)	$/ton reduced
W. A. Parish	5	DSI	50.0	7,079	$2,559
		DSI	90.0	12,741	$2,995
		SDA	92.5	13,095	$2,441
		Wet FGD	95.0	13,449	$2,389
	6	DSI	50.0	7,654	$2,699
		DSI	90.0	13,776	$3,229
		SDA	93.1	14,251	$2,401
		Wet FGD	95.4	14,603	$2,334
	7	DSI	50.0	6,168	$2,805
		DSI	90.0	11,102	$3,296
		SDA	92.7	11,432	$2,559
		Wet FGD	95.1	11,733	$2,542

6 Summary of Scrubber Upgrade Cost Results

In our Cost TSD, we analyze those units listed in Table 1 with an existing SO_2 scrubber in order to determine if cost effective scrubber upgrades are available. Because all of the scrubber systems we evaluate are wet scrubbers, we limit our analyses of scrubber upgrades to wet scrubbers. Below, we present a summary of the results of that analysis.

With the exception of San Miguel, we are limited in what information we can include in this section, because in developing our scrubber cost estimates we used information that was claimed as CBI. This information was submitted in response to our Section 114(a) requests. We can therefore only present the following summary.

With the exception of San Miguel, we propose to find that for all the units we analyzed:

- The absorber system had either already been upgraded to perform at an SO_2 removal efficiency of at least 95%, or it could be upgraded to perform at that level using proven equipment and techniques.
- The SO_2 scrubber bypass could be eliminated, and the additional flue gas could be treated by the absorber system with at least a 95% removal efficiency.
- Additional modifications necessary to eliminate the bypass, such as adding fan capacity, upgrading the electrical distribution system, and conversion to a wet stack could be performed using proven equipment and techniques.

- The additional SO_2 emission reductions resulting from the scrubber upgrade are substantial, ranging from 68% to 89% reduction from the current emission levels, and cost effective.

A summary of our analyses is as follows:

Table 15. Summary of Scrubber Upgrade Results

Unit	2009-2013 3-yr Avg. SO_2 Emissions (eliminate max and min) (tons)	SO_2 Emissions at 95% Control (tons)	SO_2 Emissions Reduction Due to Scrubber Upgrade (tons)	SO_2 Emission Rate at 95% Control (lbs/MMBtu)
W. A. Parish WAP8	2,586	836	1,750	0.04
Monticello 3	13,857	1,571	12,286	0.06
Sandow 4	22,289	4,625	17,664	0.20
Martin Lake 1	24,495	3,706	20,789	0.12
Martin Lake 2	21,580	3,664	17,917	0.12
Martin Lake 3	19,940	3,542	16,389	0.11
Limestone 1	10,913	2,466	8,446	0.08
Limestone 2	11,946	2,615	9,331	0.08

We calculated the cost effectiveness for each of these units. Because those calculations depended on information claimed by the companies as CBI we cannot present it here, except to note that in all cases, the cost effectiveness was less than $600/ton. We invite the facilities listed above to make arrangements with us to view our complete cost analysis for their units.

7 Modeled Benefits of Emission Controls

In Appendix A and attachments to Appendix A, we describe the different modeling runs we conducted for our review, our methodology and selection of emission rates, our modeling results, and our final modeling analysis that we use to evaluate the benefits of the controls and their associated emission decreases on visibility impairment values. Our modeling focused on calculating the extinction and visibility impacts and benefits at the Wichita Mountains, the Guadalupe Mountains, and Big Bend primarily, but also included analysis at a number of other Class I areas in states surrounding Texas. In evaluating the impacts and benefits of potential controls, we evaluated a number of metrics such as change in deciviews in 2018 and natural conditions situations, change in extinction, change in percentage of total extinction, recent actual emissions vs. CENRAP 2018 projected emissions, etc. For a full discussion on our review of all the modeling results, and factors that we considered in evaluating and weighing all the results, precedents, and other policy concerns please see Appendix A.

Our review of the impacts/benefits of scrubber upgrades on eight units at five facilities concluded that scrubber upgrades conducted at seven of the eight units would net significant visibility improvements at the Wichita Mountains. These seven units are: Limestone 1 and 2; Martin Lake 1, 2, and 3; Monticello 3; and Sandow 4. We project visibility benefits at Big Bend, the Guadalupe Mountains and other Class I areas, with the largest visibility benefit from these seven sources projected to occur at the Wichita Mountains. We consider the visibility improvement from a scrubber upgrade on W. A. Parish 8 would be relatively small in comparison to the other units we evaluated, and not large enough to consider as beneficial at this time.

We evaluated the visibility benefits of DSI, for the thirteen units that currently have no SO_2 control, as described in section 5. We evaluated all the units using the same control levels we employed in our control cost analyses. In summary, we evaluated these units at a DSI SO_2 control level of 50%, which we believe is likely achievable for any unit. We also evaluated each unit at its maximum recommended DSI performance level, of 80% SO_2 removal for an ESP installation and 90% SO_2 removal for a baghouse installation. As we discuss in our Cost TSD, we believe these are maximum performance levels for DSI but we do not know whether a given unit is actually capable of achieving these DSI control levels. We conducted this analysis, however, in order to be able to more closely compare DSI cost and performance with that of scrubbers. At the lower performance level we conclude that the corresponding visibility benefits from DSI would be close to half of the benefits from scrubbers. The visibility benefits from DSI are quantified specifically in Appendix A. Overall, the visibility benefits from scrubber retrofits are more beneficial.[20]

We also evaluated the visibility benefits for the thirteen scrubber retrofits listed in Tables A.6-1a-d, A.6-2a-d, A.6-4; assuming control levels corresponding to SDA and wet FGD. We conclude that installing either wet FGD or SDA scrubbers on five of these units would yield significant visibility improvements at the Wichita Mountains. These five units are: Big Brown 1 and 2, Coleto Creek, and Monticello 1 and 2. We conclude that scrubber installations on Big Brown 1 and 2 would also yield significant benefits at the Guadalupe Mountains, and that a scrubber installation on the Coleto Creek unit would also yield significant visibility benefits at Big Bend.

In comparison to the above five units, we propose to find that the visibility benefits from installing scrubbers on the W. A. Parish 5, 6, and 7 units; and Welsh 1, 2, and 3 units would not yield large enough visibility benefits to be considered at this time.

We also evaluated the visibility benefits of installing scrubbers on Tolk units 171B and 172B, limiting our analysis to SDA as discussed in section 4.. The visibility benefits of SDA scrubbers on the Tolk units are projected to occur mainly at the Guadalupe Mountains. We note that the deciview visibility benefits projected at the Guadalupe Mountains from controls on the Tolk units are smaller than those from scrubber upgrades at W. A. Parish or Welsh for impacts at the Wichita Mountains. However, when we evaluated other metrics, such as extinction benefit and

[20] Our multiple CAMx runs yielded data on three or more levels of emissions (controlled and uncontrolled) on a number of facilities and based on the data a linear relationship between emission level and visibility impairment on a source specific basis is a reasonable analytical approach. See Appendix A for more details.

percent of extinction benefits, we believe that the overall visibility benefit for installing scrubbers on the Tolk units was superior to either the W. A. Parish or the Welsh units. In particular, the Wichita Mountains has a much higher total extinction for the baseline and the 2018 projection than the Guadalupe Mountains, so the relative improvement in extinction levels is higher when the Tolk units are controlled for the Guadalupe Mountains, than if the W. A. Parish or the Welsh units were controlled for the Wichita Mountains. Therefore, considering all the visibility benefits relative to the respective Class I areas, we propose to find that the visibility benefits from installation of dry scrubbers on the Tolk units would be significant and beneficial towards the goal of meeting natural visibility conditions at Guadalupe Mountains.

8 Proposed RP and LTS Determination for San Miguel

We propose to find that the San Miguel facility has upgraded its SO_2 scrubber system to perform at the reasonably highest level that can be expected (94% based on a 2009 – 2013 average) based on the extremely high sulfur content of the coal being burned, and the technology currently available. We thus do not propose any further control. We propose to find that the San Miguel facility maintain a 30 Boiler Operating Day rolling average SO_2 emission rate of 0.60 lbs/MMBtu based on the most recent actual emissions data. We believe that based on the scrubber upgrades it has recently performed and its demonstrated ability to maintain an emission rate below this value on a monthly basis from December 2013 to June 2014 that it can consistently achieve this emission level. See our Cost TSD for more details about our analysis of the scrubber upgrades that San Miguel has performed on its unit. We are specifically soliciting comments on this proposed emission limit and the potential need for a slightly higher limit to provide sufficient operational headroom to demonstrate compliance.

9 Proposed RP and LTS Determination for Units other than San Miguel

In section 5, we present the results of our SO_2 control cost analysis for those units listed in Table 30 with no SO_2 control. In section 6, we present the results of our control cost analysis for upgrading those units equipped with underperforming wet FGD scrubbers. In Section 7, we present the results of our modeled visibility benefits for these controls. We believe that we have provided the technical analysis that was lacking in Texas' development of its RPGs for the Guadalupe Mountains and Big Bend, and in its consultations with Oklahoma for the development of the RPG for the Wichita Mountains. Further, we believe that our proposed control set, which we discuss below, developed through our reasonable progress four factor analysis, would ensure that Texas secures its share of the reductions needed for the RPGs of the Wichita Mountains, the Guadalupe Mountains, and Big Bend. Specifically, we propose to find that our technical analysis and control set makes whole our disapproval of:

- Section 51.308(d)(1)(i)(A), regarding Texas' reasonable progress four factor analysis.
- Section 51.308(d)(1)(i)(B), regarding Texas' calculation of the emission reductions needed to achieve the URPs for the Guadalupe Mountains and Big Bend.
- Section 51.308(d)(1)(ii), regarding Texas' RPGs for the Guadalupe Mountains and Big Bend.
- Section 51.308(d)(3)(i) regarding Texas' long-term strategy consultation.

- Section 51.308(d)(3)(ii) regarding Texas securing its share of reductions in other States' RPGs.
- Section 51.308(d)(3)(iii) regarding Texas' technical basis for its long-term strategy.
- Section 51.308(d)(3)(v)(C), regarding Texas' emissions limitations and schedules for compliance to achieve the RPGs for Big Bend and the Guadalupe Mountains.

We also believe that this technical analysis and control set makes whole our proposed disapproval of Oklahoma's submission under Section 51.308(d)(1), except for Section 51.308(d)(1)(vi), which we propose to approve. We believe our technical analysis provides the information that Oklahoma should have had during its consultations with Texas in order to determine whether sources in Texas should have been controlled to improve the visibility at the Wichita Mountains. We believe our proposed control set would ensure that Texas' share of the emission reductions are incorporated into Oklahoma's RPGs.

As we note in section 5, for all but one of the units we analyzed that currently have no SO_2 controls, even at the lower level of control of 50%, the cost-effectiveness of DSI was worse (higher $/ton) than either SDA or wet FGD, even with the latter options offering much greater levels of control and visibility benefit. At the higher 80% or 90% level of control, the cost-effectiveness of DSI was worse than either SDA or wet FGD in all cases. Consequently, we are not proposing that DSI be installed at any unit.

With the exception of Tolk, all of the scrubber retrofits were analyzed on the basis of both SDA and wet scrubbers. The SDA level of control was assumed to be a maximum of 95% not to go below 0.06 lbs/MMBtu. The wet FGD level of control was assumed to be a maximum of 98% not to go below 0.04 lbs/MMBtu. As we discuss in our Cost TSD, the cost-effectiveness ($/ton) of wet FGD was better than SDA in all cases except for the Tolk and Welsh units, which burn Power River Basin (PRB) coal. However, even in those cases, the cost-effectiveness of wet FGD was only 0.5 to 0.8% greater than SDA. Given the greater visibility improvement of wet FGD over SDA, we propose to base our cost/benefit reasonable progress and long-term strategy determination on wet FGD, except for the Tolk units, due to their potential water issue.

9.1 Proposed RP and LTS Determination for Scrubber Upgrades

We propose to find that the cost-effectiveness of the scrubber upgrades ($600/ton or less) to be reasonable, and that on an individual basis, any reasonable amount of visibility improvement due to their installation justifies their cost. We believe this is the case for all of the scrubber upgrades except for the Parish 8 unit. Despite the same level of cost-effectiveness of the Parish 8 unit, we do not believe that the visibility benefits are large enough to justify the implementation of a scrubber upgrade on that unit. Therefore we propose that the scrubbers for the Sandow 4; Martin Lake 1, 2, 3; Monticello 3, and Limestone 1 and 2 units be upgraded to perform at a 95% control level. This level of control corresponds to the emission limits listed in Table 16, below.

9.2 Proposed RP and LTS Determination for Scrubber Retrofits

The cost-effectiveness of the scrubber retrofits for the Welsh and Parish units are within a $/ton range that we have previously found to be cost-effective in BART determinations. However, we do not believe that their individual projected visibility improvements merit the installation of scrubbers at this time. We encourage the State of Texas to re-evaluate this determination as part of its next regional haze SIP submittal.

Similar to the scrubber upgrades, we consider the scrubber retrofits for the Big Brown units to be cost effective and we find the projected visibility benefits to be significant. We therefore propose that the Big Brown units meet emission limits corresponding to this evaluation. Our proposed SO_2 emission limits for the Big Brown units is shown in Table 16.

In comparison to the Big Brown units, the cost effectiveness of the scrubber retrofits for the Monticello, Coleto Creek, and Tolk units are less, although still well within the range that we have found acceptable for BART. Also, as we discuss in section 7, in comparison to the Big Brown units, the visibility improvements projected to occur due to the installation of the scrubber retrofits are less. For instance, as we discuss above, the visibility benefits of SDA scrubbers on the Tolk units are projected to occur mainly at the Guadalupe Mountains. Those visibility benefits are smaller than the visibility benefits at Wichita Mountains from scrubber upgrades at W. A. Parish or Welsh, which we are not proposing to control. However, when we evaluated other metrics, such as extinction benefit or percent of extinction benefits, we concluded that the overall visibility benefit for installing scrubbers on the Tolk units was superior to either the W. A. Parish or the Welsh units. Thus, we consider these visibility benefits to be significant. Consequently, we propose that the Monticello, Coleto Creek, and Tolk units meet SO_2 emission limits corresponding to this evaluation. Our proposed SO_2 emission limits for these units are shown in Table 16. In recognition of their lesser cost/benefit ratio, we are specifically soliciting comments on the appropriateness of one or more of these scrubber retrofits.

We propose that compliance be based on a 30 Boiler Operating Day (BOD) period. As the BART Guidelines direct, "[y]ou should consider a boiler operating day to be any 24-hour period between 12:00 midnight and the following midnight during which any fuel is combusted at any time at the steam generating unit."[21] To calculate a 30 day rolling average based on boiler operating day, the average of the last 30 "boiler operating days" is used. In other words, days are skipped when the unit is down, as for maintenance. This, in effect, provides a margin of safety by eliminating spikes that occur at the beginning and end of outages. Although we are not conducting BART determinations, our reasonable progress guidance notes the similarity between some of the reasonable progress factors and the BART factors contained in Section 51.308(e)(1)((ii)(A), and suggests that the BART Guidelines be consulted regarding cost, energy and non-air quality environmental impacts, and remaining useful life. We are therefore relying on our BART Guidelines for assistance in establishing the emission limit averaging period as well.

[21] 70 FR 39172 (July 6, 2005).

Table 16. Proposed 30 Boiler Operating Day SO_2 Emission Limits

	Unit	Proposed SO_2 Emission Limit (lbs/MMBtu)
Scrubber Upgrades	Sandow 4	0.20
	Martin Lake 1	0.12
	Martin Lake 2	0.12
	Martin Lake 3	0.11
	Monticello 3	0,06
	Limestone 2	0.08
	Limestone 1	0.08
	San Miguel*	0.60
Scrubber Retrofits	Big Brown 1	0.04
	Big Brown 2	0.04
	Monticello 1	0.04
	Monticello 2	0.04
	Coleto Creek 1	0.04
	Tolk 172B	0.06
	Tolk 171B	0.06

* As we note elsewhere, we do not anticipate that San Miguel will have to install any additional control in order to comply with this emission limit.

10 Proposed Natural Conditions for the Texas Class I Areas

As we discuss in our TX TSD, the TCEQ used a refined approach to calculating the natural conditions for the Guadalupe Mountains and Big Bend. This approach, among other things, requires knowledge about the amount of coarse mass and soil that is attributable to natural sources. The TCEQ has provided data that supports the conclusion that a large portion of dust impacting visibility at its Class I areas is likely due to natural sources. We agree that dust storms and other blown dust from deserts are a significant contributor to visibility impairment at the Texas Class I areas that may not be captured accurately by our default method. However, we do not believe, as the TCEQ asserts, that all coarse mass and soil can be attributable to 100% natural sources.

Although we believe that some coarse mass and soil should be attributable to natural sources, we do not have the information necessary to determine how much should be attributable to natural sources. We therefore acknowledge that like the TCEQ, we cannot accurately reset the natural conditions for the Guadalupe Mountains and Big Bend by using the TCEQ's methodology, which depends on this information. In lieu of this, we propose to rely on the adjusted default estimates for the new IMPROVE equation from the Natural Conditions II committee[22], which was the starting point for the Texas natural visibility calculations, but solicit comment on the acceptability of alternate estimates in the range between our default estimates and the Texas estimates. We propose that the natural conditions for the Guadalupe Mountains and Big Bend be set as follows:

Table 18. Natural Conditions for the Guadalupe Mountains and Big Bend

Class 1 Area	20 Percent Best Days (dv)	20 Percent Worst Days (dv)
Guadalupe Mountains	0.99	6.65
Big Bend	1.62	7.16

We recommend that the State of Texas re-evaluate the natural conditions for its Class I areas in the next regional haze SIP.

11 Calculation of Natural Visibility Impairment for the Texas Class I Areas

Using our proposed natural visibility conditions for the Guadalupe Mountains and Big Bend, we reset the amount of natural visibility impairment for these Class I areas under section 51.308(d)(2)(iv)(A). We do this by modifying the table we present in our TX TSD. We replace Texas' calculations of natural visibility for its Class I areas, with the adjusted default values (NC II), discussed above. We retain the baseline visibility values we proposed to approve in our TX

[22] Regional Haze Rule Natural Level Estimates Using the Revised IMPROVE Aerosol Reconstructed Light Extinction Algorithm, Copeland, S. A., et al, Final Paper # 48, available in our docket.;
NC II, or new IMPROVE natural visibility conditions are available at:
http://vista.cira.colostate.edu/Docs/IMPROVE/Aerosol/NaturalConditions/NaturalConditionsII_Format2_v2.xls, for which we have filtered the data for Texas Class I areas and which is also available in our docket.

TSD then recalculate the amount the baseline values exceed the natural visibility conditions. We propose that the natural visibility impairment for the Guadalupe Mountains and Big Bend be set as follows:

Table 19. Revised Visibility Metrics for the Class I Areas in Texas

Estimate of Natural Visibility Conditions		
Class I Area	Haze Index (deciviews)	
	Most Impaired	Least Impaired
Big Bend	7.16	1.62
Guadalupe Mountains	6.65	0.99
Baseline Visibility Conditions, 2000–2004		
Class I Area	Haze Index (deciviews)	
	Most Impaired	Least Impaired
Big Bend	17.30	5.78
Guadalupe Mountains	17.19	5.95
Estimate of Extent Baseline Exceeds Natural Visibility Conditions		
Class I Area	Haze Index (deciviews)	
	Most Impaired	Least Impaired
Big Bend	10.14	4.16
Guadalupe Mountains	10.54	4.96

12 Uniform Rates of Progress and the Emission Reductions Needed to Achieve Them

Section 51.308(d)(1)(i)(B) requires that we analyze and determine the rates of progress needed to attain natural visibility conditions by the year 2064 and consider the uniform rate of improvement in visibility and the emission reduction measures needed to achieve them. Below, we present the URPs for the Guadalupe Mountains and Big Bend, using the natural conditions we propose to establish above:

Figure 8. URP for Big Bend

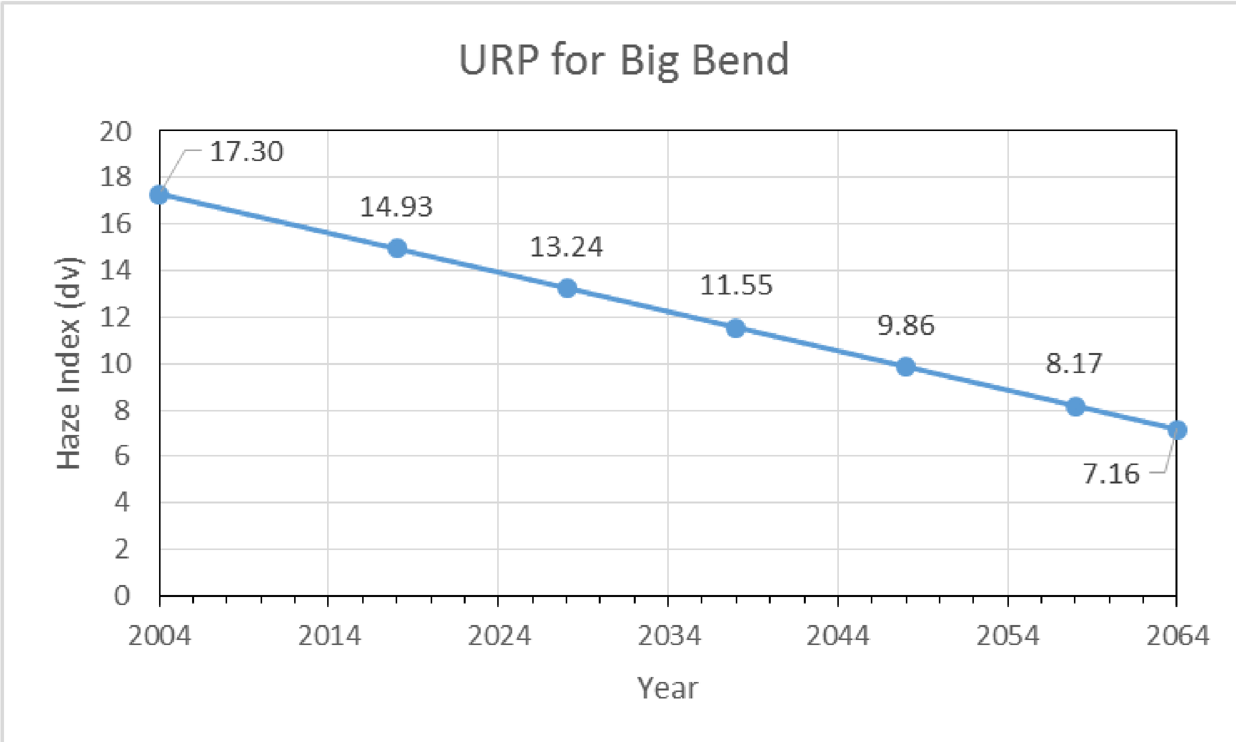
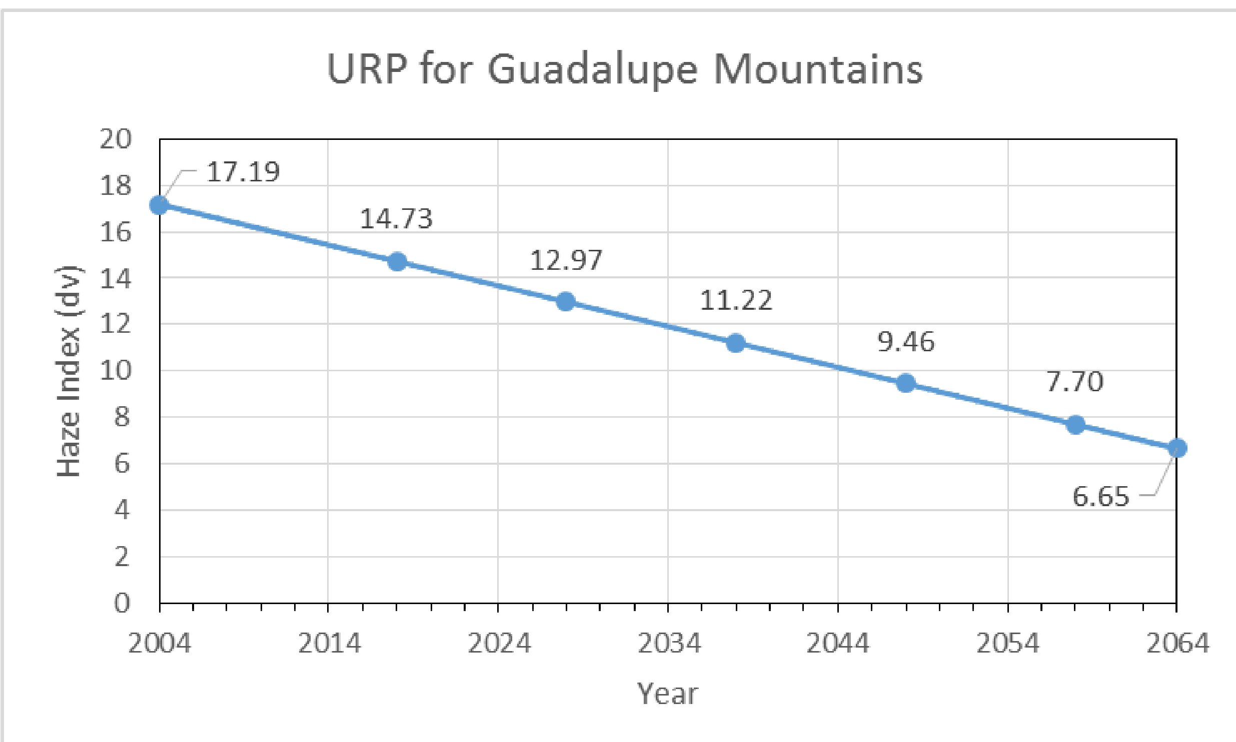


Figure 9. URP for the Guadalupe Mountains



We constructed these URPs in a spreadsheet using Texas' baseline values and our reset natural conditions, shown above in Table 19.[23] We then used the resulting equation of the line to project the values for the URP at the end of each planning period. Those values are displayed in the graphs above.

13 Reasonable Progress Goals for Oklahoma and Texas Class I Areas

We are quantifying proposed RPGs (in deciviews) for the 20-percent worst days in 2018. The proposed RPGs for Oklahoma's Class I area, the Wichita Mountains, and Texas' two Class I areas, Big Bend and the Guadalupe Mountains, account for the emission reductions from the reasonable progress control measures identified above in our proposed regional haze FIPs. The proposed RPGs reflect the results of our reasonable progress analysis of point sources as described in detail in Appendix A. These proposed RPGs are established based on an adjustment of the 2018 RPGs established by Texas and Oklahoma that were based on the 2018 CENRAP modeling. We note that we do not anticipate implementation of the identified scrubber retrofits by the end of 2018. Therefore, we are only adjusting the RPGs established by the States to reflect the additional anticipated visibility benefit from the scrubber upgrades over the 2018 projected visibility conditions. The tables below show the new adjusted RPGs as well as the additional improvement that is anticipated once all the scrubber retrofits have been implemented sometime after 2018. These new RPGs provide for an improvement in visibility on the worst days during this planning period. Table 20 below estimates the RPG if all proposed controls were implemented by 2018.[24] See Appendix A to this TSD for more information on our modeling and estimated visibility benefits from the controls proposed in this FIP.

Table 20. Proposed RPGs for 20% Worst Days based on predicted benefit of scrubber upgrades beyond 2018 CENRAP projected visibility conditions.

	Baseline (dv)	2018 CENRAP projection (dv)	Predicted additional benefit due only to FIP scrubber upgrades (dv)	Proposed RPG (dv)	Natural visibility	Number of years needed to reach natural visibility
Wichita Mountains	23.81	21.47	0.14	**21.33**	7.58	92
Big Bend	17.30	16.6	0.03	**16.57**	7.16	194
Guadalupe Mountains	17.19	16.3	0.04	**16.26**	6.65	159

[23] This spreadsheet, "TX URPs.xlsx," is in our docket.
[24] See Vis modeling summary.xlsx in the docket for this action for our calculations and estimates of visibility benefits from the examined levels of controls, and summary of visibility benefits from proposed controls.

Table 21. Calculated RPGs for 20% Worst Days based on predicted benefit of all proposed controls beyond 2018 CENRAP projected visibility conditions

	Baseline (dv)	2018 CENRAP projection (dv)	Predicted additional benefit due only to FIP scrubber upgrades (dv)	Additional benefit predicted due to FIP scrubber retrofits (dv)	Total benefit from proposed controls	RPG assuming all controls in place by 2018	Natural visibility	Number of years needed to reach natural visibility
Wichita Mountains	23.81	21.47	0.14	0.30	0.45	21.03	7.58	82
Big Bend	17.3	16.6	0.03	0.09	0.12	16.48	7.16	173
Guadalupe Mountains	17.19	16.3	0.04	0.12	0.15	16.14	6.65	141

As discussed in more detail in Appendix A, current actual emissions for many of the units that we propose to control are higher than the projected CENRAP 2018 emission rate. Therefore, the actual visibility impact due to emissions from these sources and the anticipated benefit from controls are larger than the benefits calculated above based on the 2018 CENRAP projected visibility conditions. The table below summarizes the amount of visibility benefit we anticipate will occur from the implementation of our proposed FIP controls and the resulting emission reductions from the current actual average annual emissions.

Table 22. Anticipated Visibility Benefit due to Emission Reductions from Actual Emission levels.

	Predicted benefit due to FIP scrubber upgrades (dv)	Benefit predicted due to FIP scrubber retrofits (dv)	Total benefit from proposed controls (dv)
Wichita Mountains	0.28	0.33	0.62
Big Bend	0.07	0.10	0.17
Guadalupe Mountains	0.07	0.12	0.20

We propose to find that it is not reasonable to provide for rates of progress at the Wichita Mountains, Big Bend, or the Guadalupe Mountains that would attain natural visibility conditions by 2064 (i.e., the URP). Our demonstration that a slower rate of progress is reasonable is based on the reasonable progress analyses performed by us and the States that considered the four statutory reasonable progress factors, as described above. Although progress is slower than the URP, the proposed FIP would provide for RPGs that reflect an improved rate of progress and a shorter time period to reach natural visibility conditions at each of the Class I areas, compared with the RPGs established by Texas and Oklahoma in their regional haze SIPs. We have provided an estimate of the number of years needed to meet natural visibility conditions at the rate of progress proposed by us as reasonable. We have also estimated the RPG and the number of years to meet natural visibility conditions if all proposed controls were in place by 2018. We note that this does not take into account the visibility benefit from scrubber retrofits included in this proposed FIP that will be implemented after 2018.

Appendix A. EPA's Visibility Projection Modeling

A.0 Background and Introduction

TCEQ analyzed available monitor data and source apportionment modeling to identify the pollutants and source categories that most impact visibility at Class I areas in Texas and surrounding areas. The primary anthropogenic emissions that impact visibility are NOx and SO_2 emissions from point sources. For further details of TCEQ's analysis and conclusions see our TX TSD. Based on our review of TCEQ's analysis and our assessment of TCEQ's conclusions, we conducted our own analysis to identify those sources with the largest potential to impact visibility, evaluate the impacts of these select sources in Texas and determine if reasonable controls were available that were overlooked by Texas in their evaluation of sources that would lead to visibility impairment improvement at Class I areas in Texas and surrounding areas including WIMO.

In the process of developing the modeling analyses for evaluating the Texas regional haze plan, EPA Region 6 received assistance in conducting modeling runs from ENVIRON, a consultant to RTI International under contract EP-W-11-029, Work Assignment No. 3-09.

Q/D ANALYSIS - GENERAL

EPA, States and RPOs have historically used a Q/D analysis to identify those facilities that have the potential to impact visibility at a Class I area based on their emissions and distance to the Class I area. These identified facilities could then be considered for further evaluation under the four factors for reasonable controls.

We also used a Q/D analysis as an initial screening test to identify emission sources that may impact air visibility at Class I areas. Where,

- Q is the annual emissions in tons per year (tpy)
- D is the nearest distance to a Class I Area in kilometers (km)

We used a Q divided by a value of ten as a threshold for initial identification of sources for further evaluation for RP controls, where Q is combined annual emissions of NOx and SO_2. We selected this value based on guidance contained in the BART Guidelines, which states:

> Based on our analyses, we believe that a State that has established 0.5 deciviews as a contribution threshold could reasonably exempt from the BART review process sources that emit less than 500 tpy of NOx or SO_2 (or combined NOx and SO_2), as long as these sources are located more than 50 kilometers from any Class I area; and sources that emit less than 1000 tpy of NOx or SO_2 (or combined NOx and SO_2) that are located more than 100 kilometers from any Class I area.[25]

The approach described above corresponds to a Q/D threshold of ten. This approach has also been recommended by the Federal Land Managers' Air Quality Related Values Work Group

[25] See 40 CFR part 51, app. Y, § III (How to Identify Sources "Subject to BART").

(FLAG)[26] as an initial screening test to determine if an analysis is required to evaluate the potential impact of a new or modified source on air quality related value (AQRV) at a Class I area. For this purpose, a Q/D value is calculated using the combined annual emissions in tons per year of sulfur dioxide (SO_2), oxides of nitrogen (NO_x), particulate matter less than 10 microns (PM_{10}), and sulfuric acid mist (H_2SO_4) divided by the distance to the Class I area in km. A Q/D value greater than 10 requires a Class I area AQRV analysis.

In the Texas Regional Haze SIP, TCEQ performed a Q/D analysis based on 2018 projected emissions for SO_2 and NOx as part of the analysis to identify point sources for potential control. TCEQ calculated Q/D for NOx and SO_2 separately for each point source with emissions greater than 100 tons per year and compared that to a threshold of 5. Appendix 10-1 of the Texas RH SIP describes the two step process (reproduced below) utilized by TCEQ to identify sources:

> The best candidate sources for proposed control strategies were identified with a two step process. First, sources with potential control strategy costs greater than \$2,700 per ton SO_2 for NOX were initially screened out to limit the population to potential sources with relatively cost effective control strategies. The group of sources was further reduced to eliminate sources that are so distant from any of the ten Class I areas that any reduction in emissions would be unlikely to have a perceptible impact on visibility. The list was restricted to those sources with a ratio of estimated projected 2018 base annual emissions (tons) to distance (kilometers) greater than five to any Class I area. Also, any source with predicted 2018 emissions less than 100 tons per year was excluded. The regulatory and logistical overhead associated with controlling these small sources would not be justified by the likely benefit.

For our review of TCEQ's Q/D analysis and use of a cost threshold see the Texas TSD for this action and why we conducted our own Q/D analysis.

A.1 Emissions Data and EPA's Q/D Analysis

CALCULATION

We evaluated annual emission inventory data for point sources available from the TCEQ. The Texas point sources are defined as industrial, commercial, or institutional sites that meet the reporting requirements of 30 Texas Administrative Code (TAC) §101.10. Permitted point sources in Texas are required to submit annual emissions inventories. The data are drawn from TCEQ's computer-based State of Texas Air Retrieval System (STARS). Annual emission data from 2009[27] were utilized to calculate the Q/D value for all point sources with reported

[26] Federal Land Managers' Air Quality Related Values Work Group (FLAG), Phase I Report—Revised (2010) Natural Resource Report NPS/NRPC/NRR—2010/232, October 2010. Available at http://www.nature.nps.gov/air/Pubs/pdf/flag/FLAG_2010.pdf

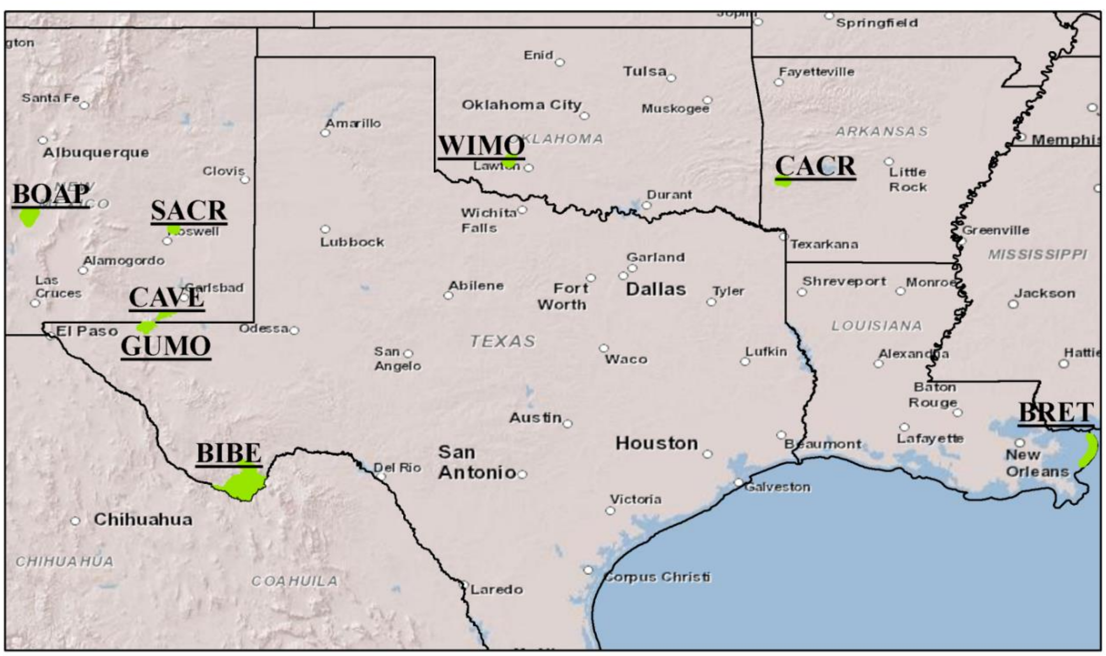
[27] 2009 emissions data available at http://www.tceq.texas.gov/assets/public/implementation/air/ie/pseisums/2009statesum.xlsx. Available in the docket as "2009statesum.xlsx"

emissions in Texas for all Class I areas within Texas and nearby Class I areas in surrounding states (Table A.1-1 and Figure A.1-1). Latitude and longitude for each facility was obtained from a separate STARS emission inventory[28] with unit specific emissions. Distances between each facility and nearby Class I areas were then calculated using ArcGIS software. For plots for each Class I area see Figures A.1-3a-h at the end of Section A.1.

Table A.1-1. Class I areas included in Q/D Analysis

Site	State	Code	State FIPS	County	County FIPS	Latitude	Longitude	LCP X (km)	LCPY (km)
Breton Wilderness Area	LA	BRET1	22	St. Bernard Parish	87	29.1189	-89.2066	763	-1176
Big Bend National Park	TX	BIBE1	48	Brewster County	43	29.3027	-103.178	-604	-1167
Guadalupe Mountains	TX	GUMO 1	48	Culberson County	109	31.833	-104.809	-738	-873
Wichita Mountains Wilderness	OK	WIMO 1	40	Comanche County	31	34.7323	-98.713	-156	-581
Carlsbad Caverns NP.	NM	GUMO 1				31.833	-104.809	-738	-873
Caney Creek Wilderness Area	AR	CACR 1	5	Polk County	113	34.4544	-94.1429	261	-610
Bosque del Apache Wilderness Area	NM	BOAP 1	35	Socorro County	53	33.8695	-106.852	-906	-629
Salt Creek Wilderness Area	NM	SACR1	35	Grant County	17	33.4598	-104.404	-685	-696

Figure A.1-1. Class I areas included in EPA Q/D Analysis



[28] Downloaded from TCEQ at ftp://ftp.tceq.texas.gov/pub/ChiefEngineer/adam/EPA-R6-Data/ in April 2011. Available in the docket as 2009TCEQpointSOURCEdata.mdb.

RESULTS

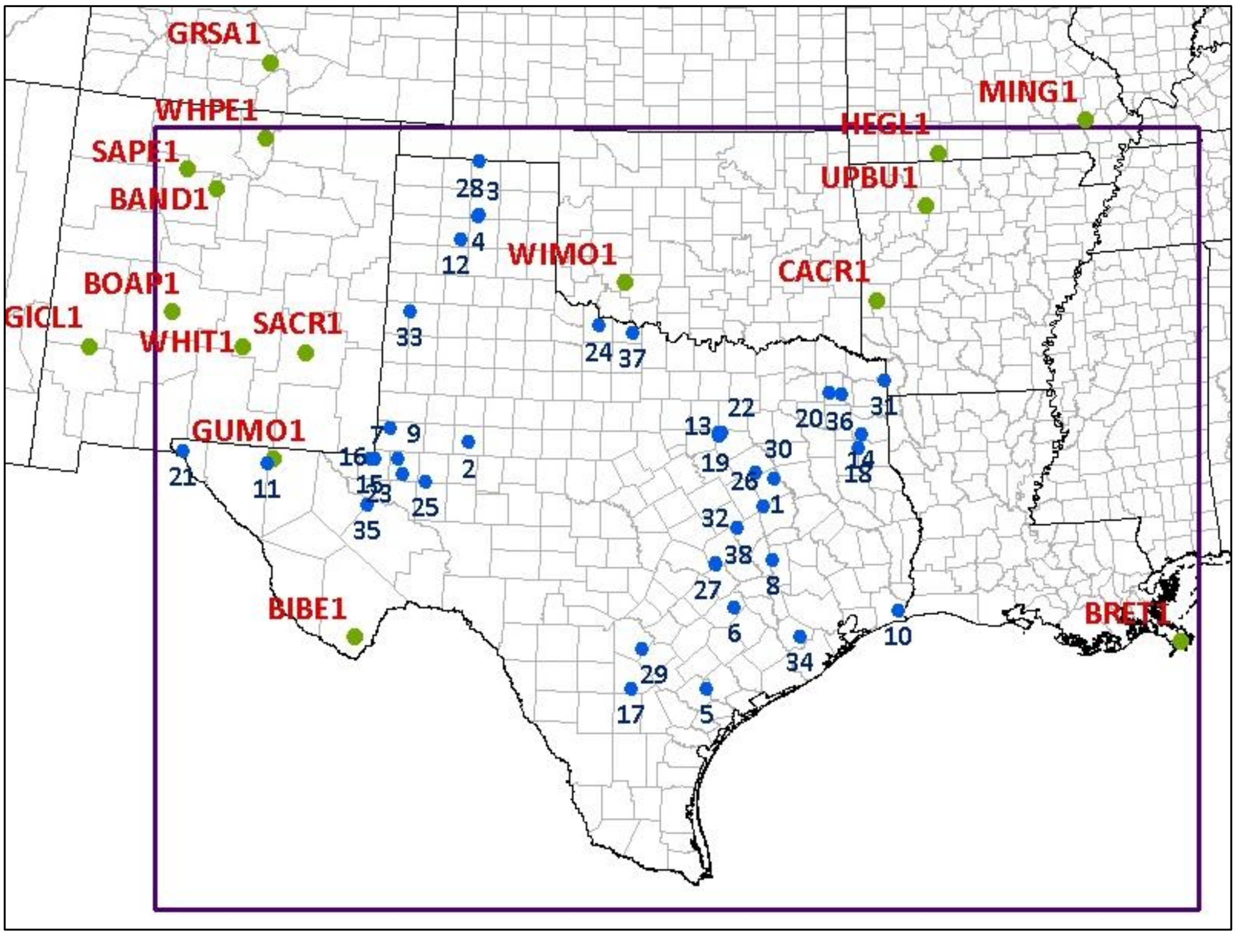
We calculated a Q/D value for each point source and Class I area using the sum of actual 2009 annual SO_2 and NOx emissions. Those facilities with a Q/D value greater than 10 were identified for further analysis using source-apportionment modeling. This approach aims to identify those facilities with the largest potential to impact visibility at a Class I area. The Q/D method does not take into account any specific conditions at the emitting source (e.g., stack parameters) and does not account for meteorology/transport phenomena. As further discussed in Section A.2 below, facilities identified through the Q/D analysis were then included in a photochemical modeling scenario utilizing source apportionment to quantify the visibility impacts from each source. Due to computation resource limitations, it is not possible to include a large number of facilities in the photochemical modeling episode utilizing source apportionment. The Q/D analysis and use of the threshold value of ten narrows the number of facilities to examine to those with the largest potential for impact and to a manageable number for this planning period. Table A.1- 2 below lists the emissions and the Q/D value for the nearest Class I area for the identified sources with Q/D greater than 10. Figure A.1-2 plots these 38 facilities with a Q/D greater than 10 on a map of Texas and the surrounding area.

Table A.1-2. Sources identified through EPA's Q/D Analysis for inclusion in source-apportionment analysis

Map location	Facility	NOx (tpy)	SO2 (tpy)	Nearest Class I area	Distance (km)	Q/D
1	BIG BROWN STEAM ELECTRIC STATION	5794.68	55547.40	CACR	335	182.9
2	BIG SPRING CARBON BLACK	567.01	8876.88	CAVE	280	33.8
3	BORGER CARBON BLACK PLANT	361.98	3306.74	WIMO	262	14.0
4	BORGER CARBON BLACK PLT (Sid Richardson)	662.40	6150.70	WIMO	262	26.0
5	COLETO CREEK POWER STATION	4198.11	21453.35	BIBE	558	46.0
6	FAYETTE POWER PROJECT (Sam Seymor)	6224.53	27551.11	CACR	554	61.0
7	FULLERTON GAS PLANT	1659.65	869.00	CAVE	150	16.9
8	GIBBONS CREEK	2114.07	11930.82	CACR	456	30.8
9	GOLDSMITH GAS PLANT	957.50	999.98	CAVE	166	11.8
10	OXBOW CALCINING LLC (Great Lakes Carbon)	688.40	10333.08	BRET	483	22.8
11	GUADALUPE COMPRESSOR STATION	668.05	0.01	GUMO	5	138.5
12	HARRINGTON STATION POWER PLANT	7695.50	22188.86	WIMO	277	107.8
13	*MIDLOTHIAN PLANT (HOLCIM)	951.04	1661.31	WIMO	289	
14	AEP PIRKEY POWER PLANT	3327.60	4363.10	CACR	215	35.8
15	KEYSTONE COMPRESSOR STATION	1661.97	0.29	CAVE	122	13.6
16	KEYSTONE GAS PLANT	1945.07	373.27	CAVE	128	18.1
17	LIGNITE FIRED POWER PLANT (San Miguel)	3102.52	11227.05	BIBE	435	32.9
18	MARTIN LAKE ELECTRICAL STATION	15710.02	71848.79	CACR	238	367.4
19	*MIDLOTHIAN PLANT (TXI)	1022.40	550.20	WIMO	289	
20	MONTICELLO STEAM ELECTRIC STATION	11944.54	58269.05	CACR	165	425.4
21	NEWMAN STATION	1726.01	6.34	GUMO	133	13.0
22	MIDLOTHIAN PLANT (Ashgrove or North Texas Cement)	1266.20	2696.69	WIMO	289	13.7
23	ODESSA CEMENT PLANT	2352.56	225.29	CAVE	179	14.4
24	OKLAUNION POWER STATION	4318.44	2355.00	WIMO	79	85.0
25	PEGASUS GAS PLANT	2312.01	62.50	CAVE	219	10.8
26	LIMESTONE ELECTRIC GENERATION STATION	11900.92	20666.61	CACR	383	85.1
27	SANDOW STEAM ELECTRIC STATION	4916.02	25597.31	WIMO	484	63.0
28	SHERHAN GAS PLANT	2530.52	764.82	WIMO	310	10.6
29	CALAVERAS PLANT (Sommers Deely Spruce)	7259.44	17936.31	BIBE	443	56.9
30	STREETMAN PLANT	698.85	3560.79	CACR	342	12.5
31	TEXARKANA MILL	1602.26	90.62	CACR	123	13.7
32	TWIN OAKS POWER (TNP one)	1479.13	4705.71	CACR	436	14.2
33	TOLK STATION	3709.56	22639.37	SACR	177	148.5
34	WA PARISH ELECTRIC GENERATING STATION	5041.38	42484.17	CACR	563	84.3
35	WAHA FIELD PLANT	322.00	3478.76	CAVE	157	24.3
36	WELSH POWER PLANT	10383.40	26606.50	CACR	161	230.1
37	WORKS NO 4	5121.52	587.52	WIMO	79	72.4
38	**SANDOW 5 GENERATING PLANT	190.64	227.60	WIMO	484	

*****The Midlothian Plant site name is associated with three separate facilities: Ashgrove, TXI and Holcim. The Ashgrove facility is the only one of the three to meet the Q/D threshold but all three facilities were included in the source-apportionment analysis to avoid confusion and to compare impacts from varying emission levels at three closely located emission points.
****** Sandow 5 Generating Station came online in 2009 and is well controlled. It was included in the source apportionment analysis for comparison with the impacts from higher emissions from the older Sandow Station unit located nearby.

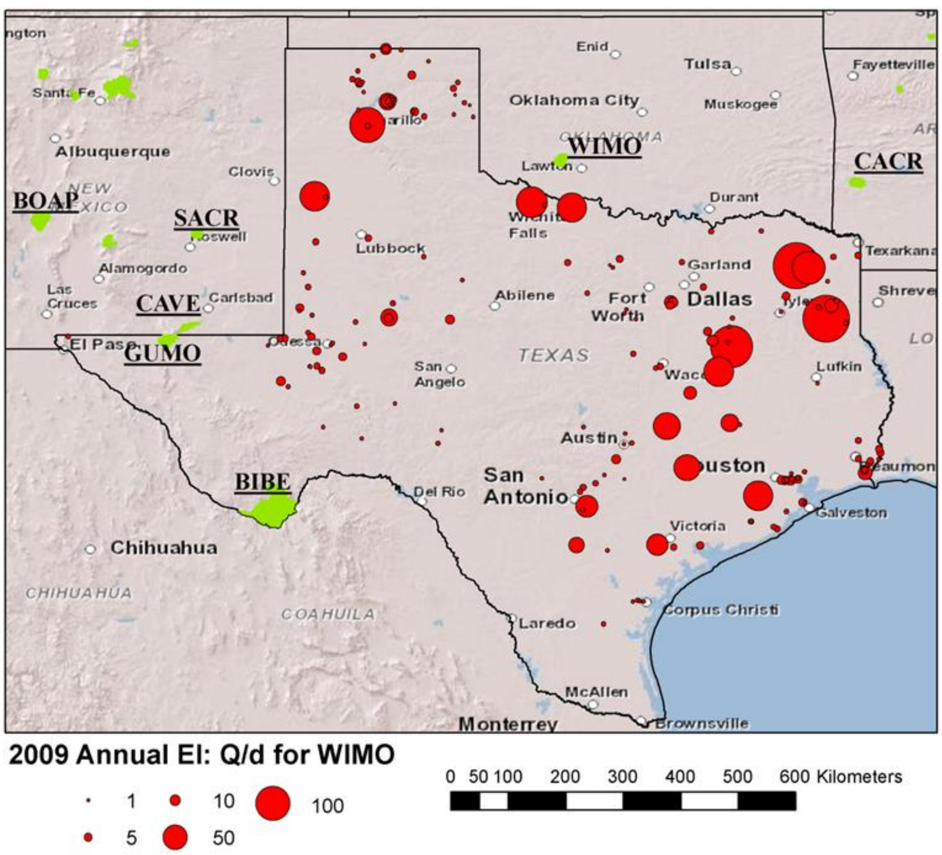
Figure A.1-2. Location of Selected Sources



UPDATED EMISSIONS ANALYSIS

After the initial Q/D analysis was completed TCEQ emission inventories for 2010 and 2011 became available.[29] We recalculated Q/D values using the more recent facility annual emission inventories. Compared to the 2009 analysis, four facilities have decreased emissions in 2010 and 2011 and fall below the Q/D threshold of 10: Keystone Compressor Station, Odessa Cement Plant, Sherhan Gas Plant and Waha Field Plant. In 2010, the two units at Oak Grove Power Station in Robertson County came online. This facility exceeds the Q/D threshold of 10 for 2010 and 2011. However, these new units are equipped with scrubbers and selective catalytic reduction and are currently well controlled. One additional facility had an increase in emissions from 2009 and exceeds the Q/D threshold for 2011, the Echo Carbon Black Plant in Orange County. The Oxbow Calcining facility (formerly Great Lakes Carbon) is approximately 45 km south west of Echo Carbon Black and has about twice the emissions of SO_2. Source apportionment results for the Oxbow facility will provide some indication of the potential impacts from the Echo Carbon Black Plant.

Figure A.1-3a. Q/D for WIMO using 2009 Annual EI



[29] 29 2010 and 2011 emissions data available at http://www.tceq.texas.gov/assets/public/implementation/air/ie/pseisums/2010statesum.xlsx. And http://www.tceq.texas.gov/assets/public/implementation/air/ie/pseisums/2011statesum.xlsx. Available in the docket as “2010statesum.xlsx” and “2011statesum.xlsx”

Figure A.1-3b. Q/D for CACR using 2009 Annual EI

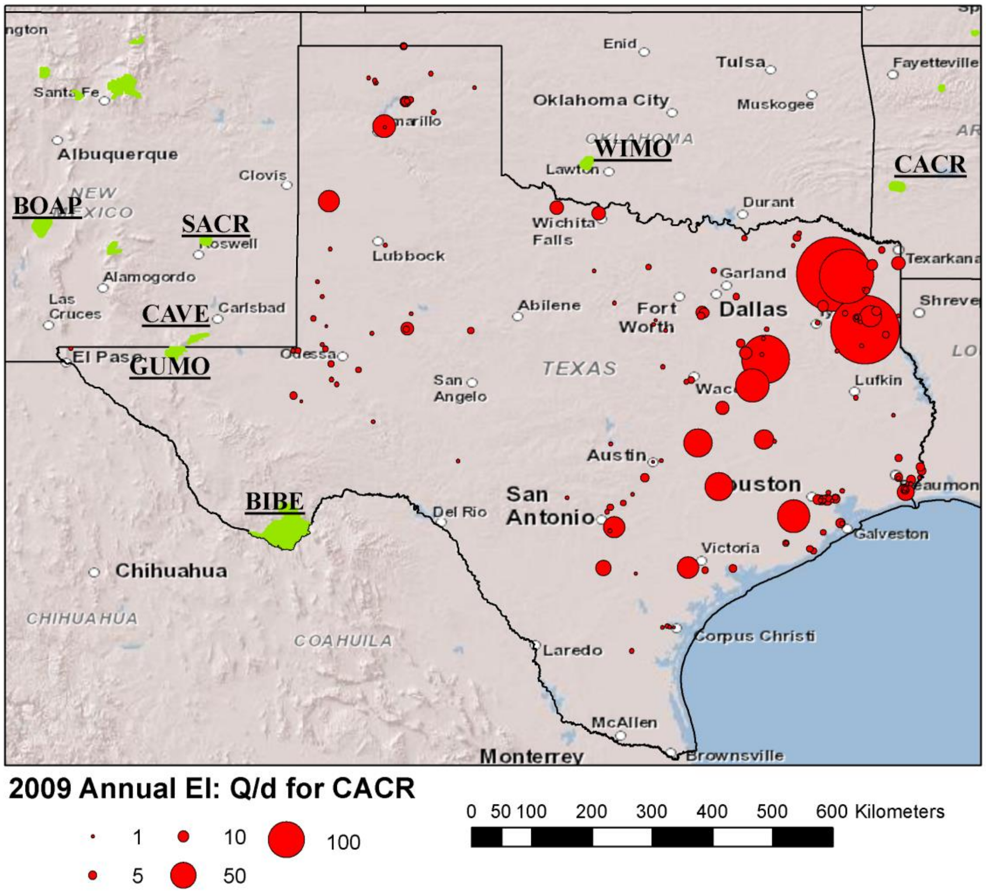


Figure A.1-3c. Q/D for BIBE using 2009 Annual EI

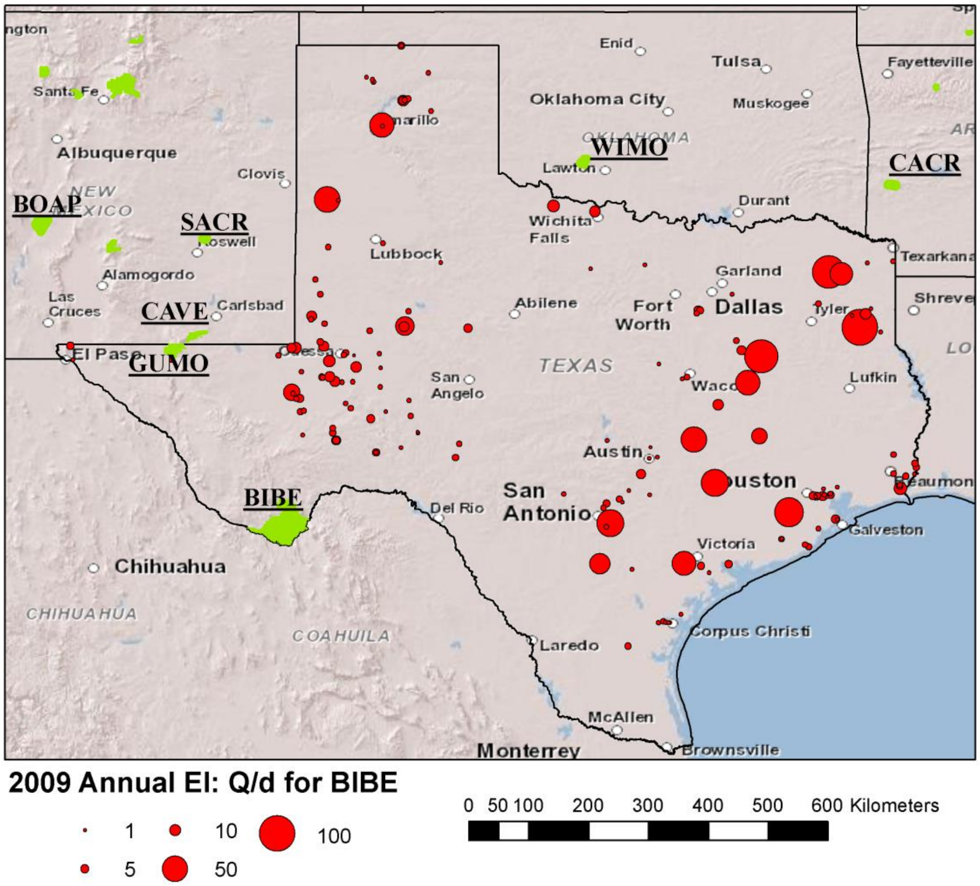


Figure A.1-3d. Q/D for GUMO using 2009 Annual EI

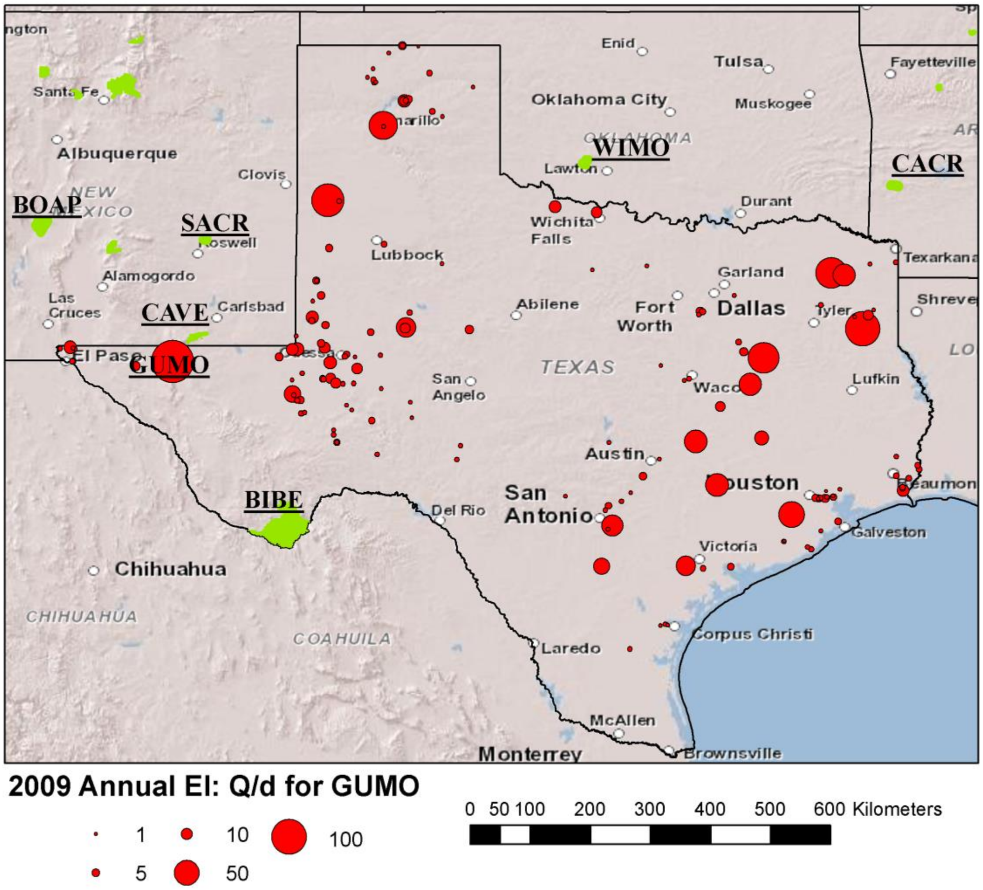


Figure A.1-3e. Q/D for CAVE using 2009 Annual EI

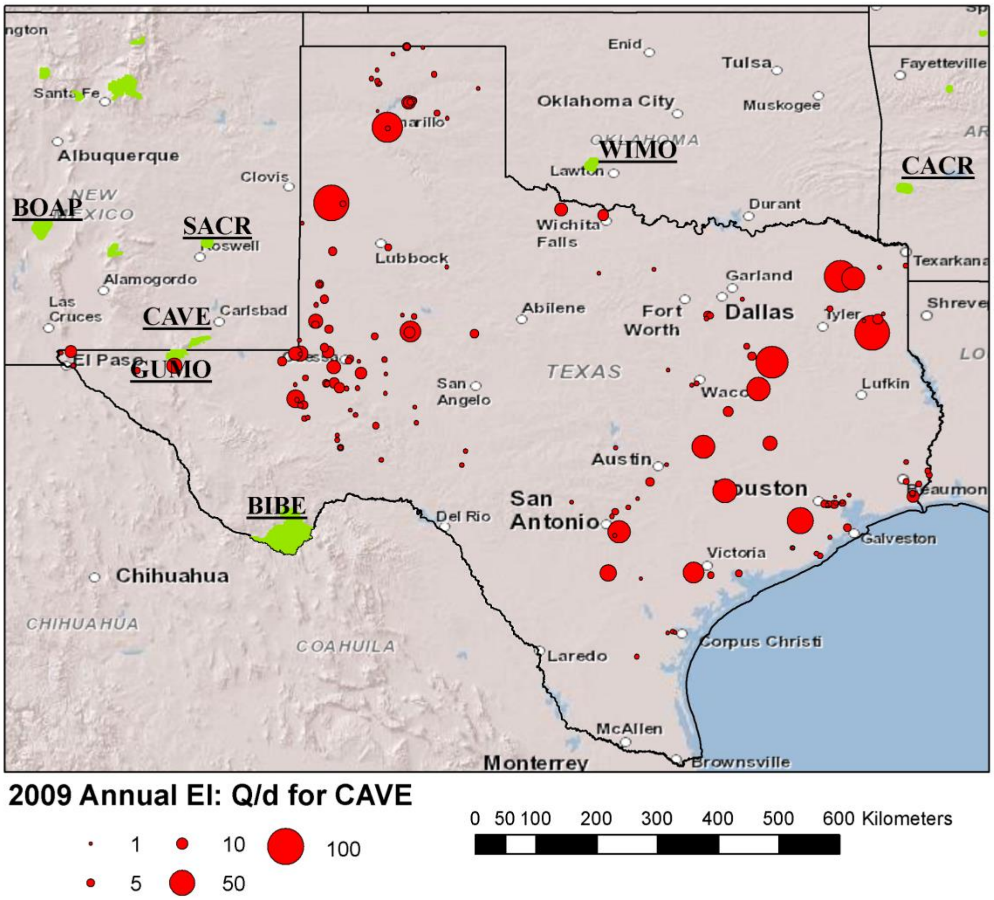


Figure A.1-3f. Q/D for BRET using 2009 Annual EI

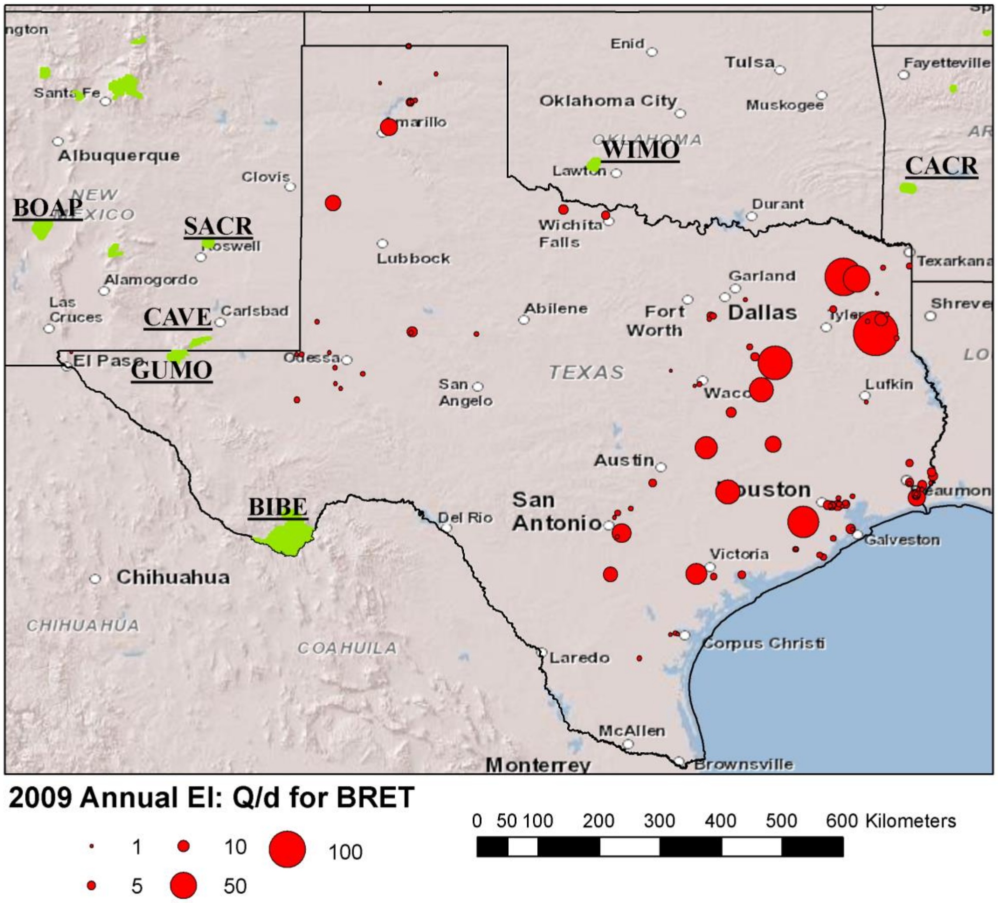


Figure A.1-3g. Q/D for SACR using 2009 Annual EI

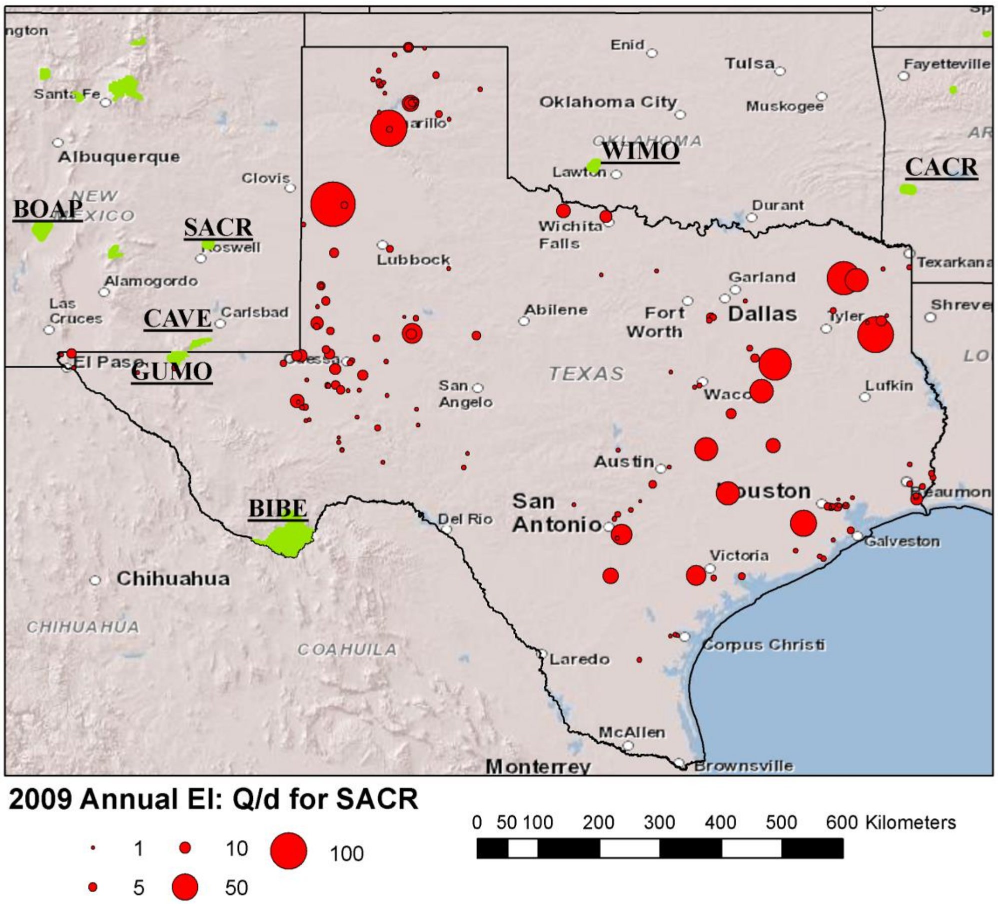
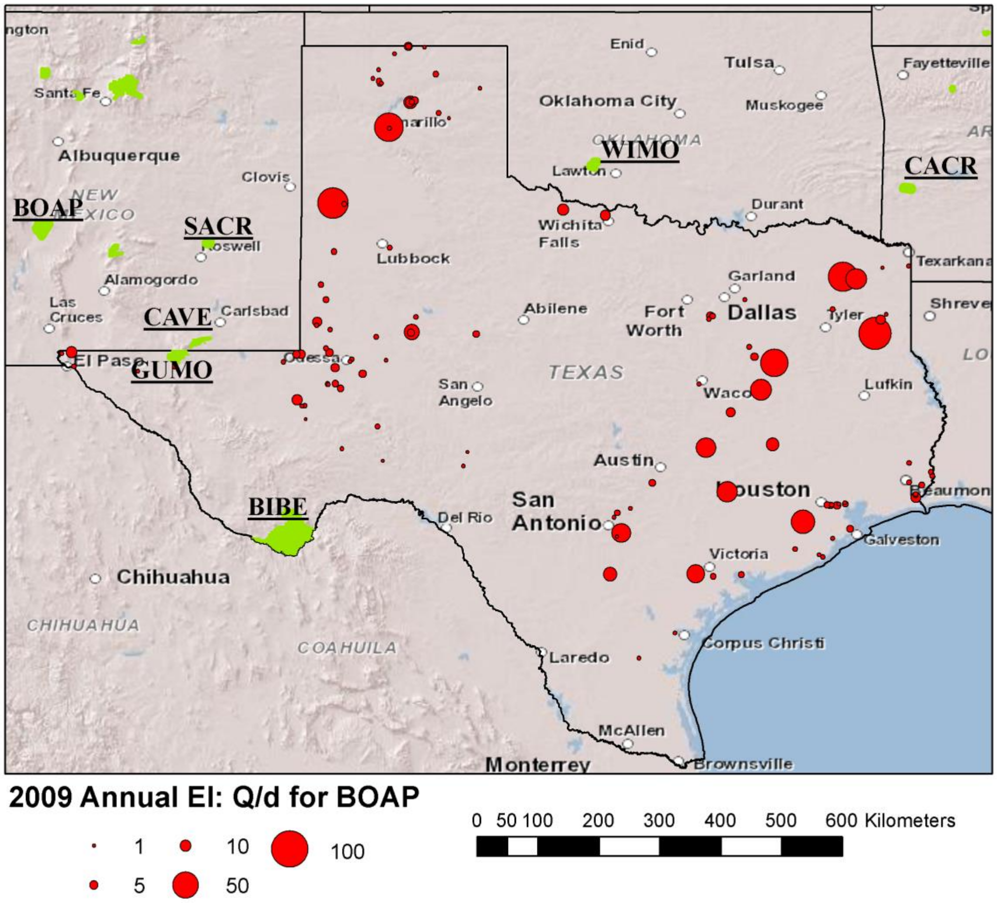


Figure A.1-3h. Q/D for BOAP using 2009 Annual EI



A.2 Initial Source Apportionment Modeling for 38 Q/D sources

After conducting the Q/D analysis, which resulted in identification of 38 facilities that were potentially the larger contributors to downwind Class I areas, we determined we should evaluate these sources for meteorology/transport to determine which of the 38 facilities had large impacts during the average 20% Worst Days and also their impacts on specific days within the 20% worst days. As mentioned above, we contracted with RTI/Environ to conduct the modeling analyses needed to evaluate the 38 facilities in Texas and assess their visibility impairment impacts at Class I areas in Texas and surrounding areas. Our current analysis builds upon modeling of 2002 and 2018 conducted previously for CENRAP by ENVIRON.

In particular, the CENRAP 2002 and 2018 36 km modeling databases for CAMx were enhanced to include a 12 km grid over Texas and nearby Class I areas. The overall approach to the project included the following steps:

- Update CENRAP 2002 and 2018 modeling databases to use with the latest release of CAMx (v5.41)
- Conduct 2002 modeling with Plume-in-Grid (PiG) and a 12-km flexi-nest grid to provide the new 2002 baseline RH modeling
- Conduct 2018 modeling with PiG and the CAMx PM Source Apportionment Technology (PSAT) for 38 facilities selected by EPA's Q/D analysis
- Evaluate impact of selected sources on visibility in Class I areas (further discussed in Sections A.3 and A.4)

2002

The ENVIRON memorandum titled "2002 Baseline CAMx Simulation, Texas Regional Haze Evaluation" documents the new 2002 baseline modeling setup and results.[30] From this point this memo will be referred to as "ENVIRON 2002 Memo". Please see the ENVIRON 2002 Memo for full details. We touch on some specific issues that we analyzed and made decisions in the discussion below.

We utilized PiG for all the 38 selected sources in order to utilize the PSAT within the PiG. We also utilized PiG for other large point sources of NOx and SO_2 within the modeling domain for both the 2002 and 2018 model runs as would typically be done in current day SIP modeling. Selection of sources and emissions thresholds for PiG treatment (for other than the 38 sources) was based on balancing PiG treatment with model run time. For the 38 selected sources we used the CENRAP 2002 Typical G inventory emission rates as were previously modeled. Documentation of these emission rates, preprocessors and other model selection options is included in the ENVIRON 2002 Memo. While we expect slight differences in 2002 projections compared to the CENRAP 2002 projections due to the model and preprocessor updates, options selections, the use of a 12 km flexinest, etc., we conducted both the 2002 and 2018 model runs with these same new procedures, etc., to enable an 'apples to apples' comparison between the base and future runs. The ENVIRON 2002 Memo also included modeling results of annual average pollution levels, daily speciated visibility impairment on Best 20% (B20%) and Worst 20% (W20%) days at different Class I areas. This information was compared with previous

[30] Electronic file included in the docket as "Memo_TXHAZE_2002CAMx_ENV_29July2013.docx"

CENRAP modeling results for 2002 and overall were very similar, therefore validating the modeling had been replicated with the updated procedures and techniques.

2018

The ENVIRON memorandum titled "2018 Base Case CAMx Simulation, Texas Regional Haze Evaluation" documents the new 2018 future base case modeling setup and results.[31] From this point this memo will be referred to as "ENVIRON 2018 Memo". Please see the ENVIRON 2018 Memo for full details. We touch on some of the specific issues that we analyzed and made decisions in the discussion below.

In addition to things discussed above, EPA started with the CENRAP 2018 Emission Inventory and made some adjustments based on review of information that had changed for specific units/facilities. These included:

- Updated emissions to 8 facilities and added one new facility:
  - One new unit at Sommers/Deely/Spruce power plant site
  - Two new units at Sandow 5 Generating Plant (new plant)
  - Three new units at WA Parish Station carried over from the 2002 CENRAP inventory and emission changes to one existing unit
  - Emission changes at North Texas Cement (Ash grove) to reflect shutting down two units and rebuilding the third unit
  - Emission changes to reflect recently installed controls or improvements in control efficiencies on power plants at Sommers/Deely/Spruce, Big Brown, Gibbons Creek, Sandown Steam Electric Station, Monticello Steam Electric Station, and Fayette Power Project

As we discuss in more detail below, we considered updating these emissions for the Cross State Air Pollution Rule (CSAPR) or the Mercury and Air Toxics Standards (MATS), but based on recent information and recent actual emissions from CEMS we were uncertain that any significant addition reductions would be expected from Texas EGU sources in the next couple of years. Also, based on recent comments from the TCEQ, it was also unclear if any further SO_2 or NOx reductions would occur due to these rules even if all litigation was resolved. The TCEQ has provided extensive comments on recent emission inventory indicating that further significant reductions in SO_2 were not expected due to CSAPR or MATS.[32] We thought it was reasonable to continue to rely upon the initial CENRAP 2018 modeling inventory initially and update the information that we were more certain about as discussed above. We utilized 2009-2013 CEM data for EGUs in evaluation and selection of updated emission levels to model.[33] Comparison of recent CEM data with CAIR projections indicated that the Texas EGUs were on track to meet the CAIR requirements without further substantial reductions. For the ENVIRON modeling we did not increase emissions for existing sources based on recent actuals but we did lower emissions

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[31] Electronic file included in the docket as "Memo_TXHAZE_2018CAMx.7Sept13.docx"

[32] TCEQ comment letter to EPA on draft modeling platform dated June 24, 2014. '2018 EMP signed.pdf'

[33] Emission rates/data used in modeling are included in the report and electronic file "Summary_emissions_for_39_selected_072913_ENV.xlsx" and CEM data included in file "TX Sources of Interest Emissions 2007-2012_msf_annual estimates.xls"

for some sources when controls had been installed and relied on post-control actuals to support modeled emission rates. TCEQ in recent ozone attainment modeling has also used recent CEM data to represent expected emissions levels from Texas EGUs for future year of 2018 in recent Houston and DFW area modeling.

As discussed in the workplan, ENVIRON ran PSAT with PiG with Chemistry to evaluate the impacts of the 38 selected sources at Class I areas in Texas and surrounding areas. ENVIRON did some comparisons of the 2018 base case simulation and concluded that overall the air quality maps (by pollutant) show consistent spatial patterns between 2002 and 2018 with lower concentrations predicted in the 2018 base case. The modeling also showed that sulfate is the main constituent that contributes to visibility impairment at the Class I areas in Texas and in other nearby Class I areas for both the B20% and W20% days. Overall the 2018 projections match with what would be expected based on the CENRAP 2018 base case, therefore the new analysis comports with expectations and is acceptable for using to evaluate single facility/source impacts on visibility impairment. The full model results included source contribution to 2018 Deciview Haze Index, source contribution to 2018 Light extinction by species, percent of total extinction, percent of total extinction by species, and URP/2018 RP for a number of Class I areas including WIMO, BIBE, and GUMO. The full modeling results are included in the ENVIRON 2018 Memo and spreadsheets that are attachments to the memo.[34] We are including projections for WIMO, BIBE, and GUMO from the ENVIRON 2018 Memo as an example of the information in the following five Figures A.2-1 through A.2-18, for additional Class I areas see the ENVIRON 2018 Memo and associated spreadsheets.

[34] Electronic files in the docket “EPA_txbart3612k_Vis_2002_2018_PSAT_Projected_072913.xlsx”, and “EPA_txbart3612k_Vis_2002_2018_PSAT_GlidePath_FOR_ENVIRON.xlsx”_

Figure A.2 -1. Source Contribution to 2018 Deciview over 20%Worst Days at WIMO, OK

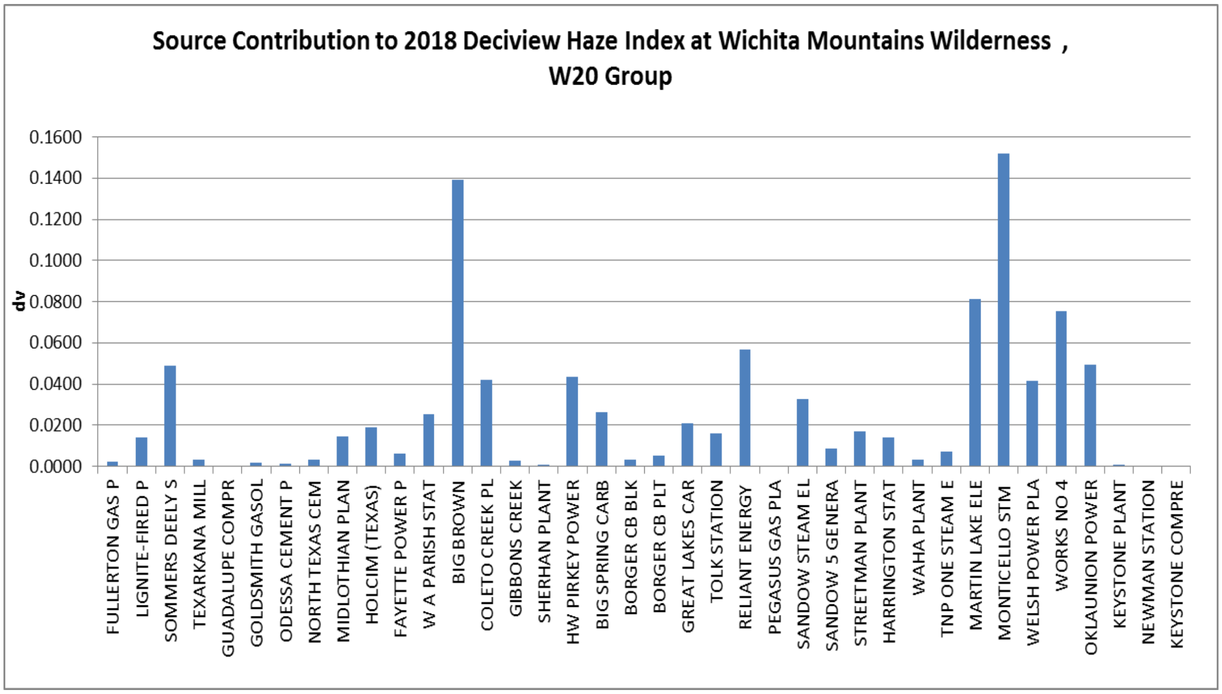


Figure A.2 -2. Source Contribution to 2018 Light Extinction by species over 20%Worst Days at WIMO, OK

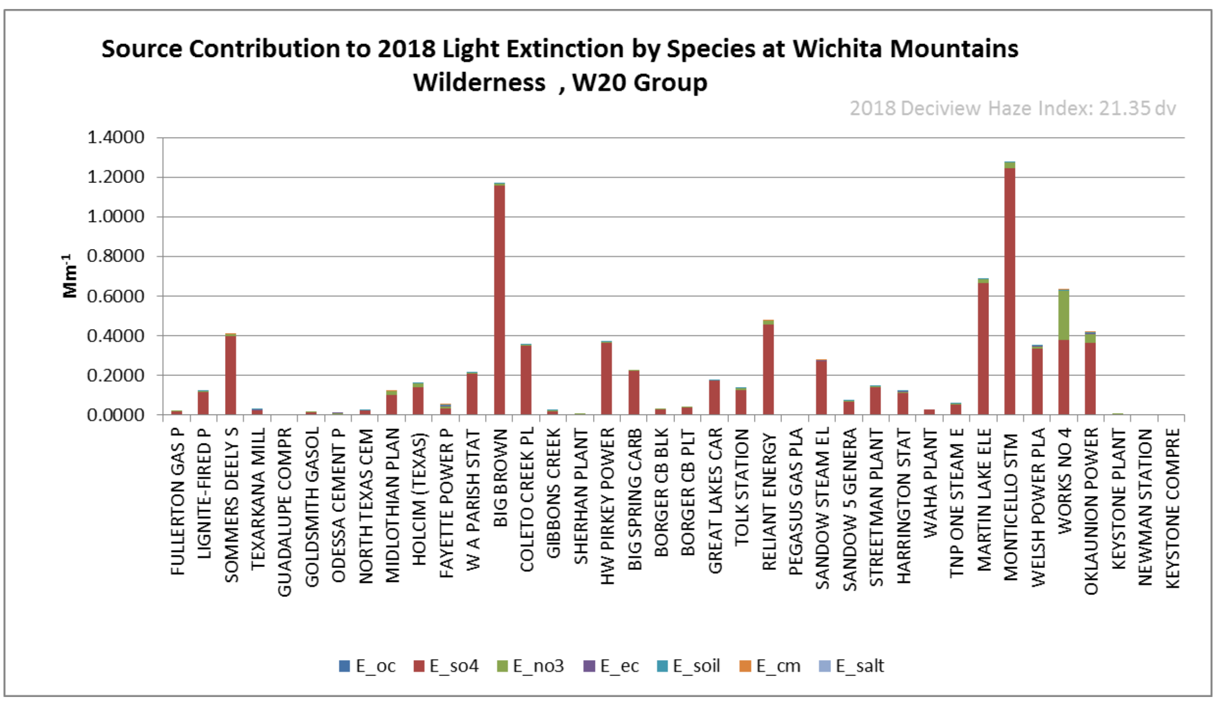


Figure A.2 -3. Percentage of Total Extinction over 20%Worst Days at WIMO, OK

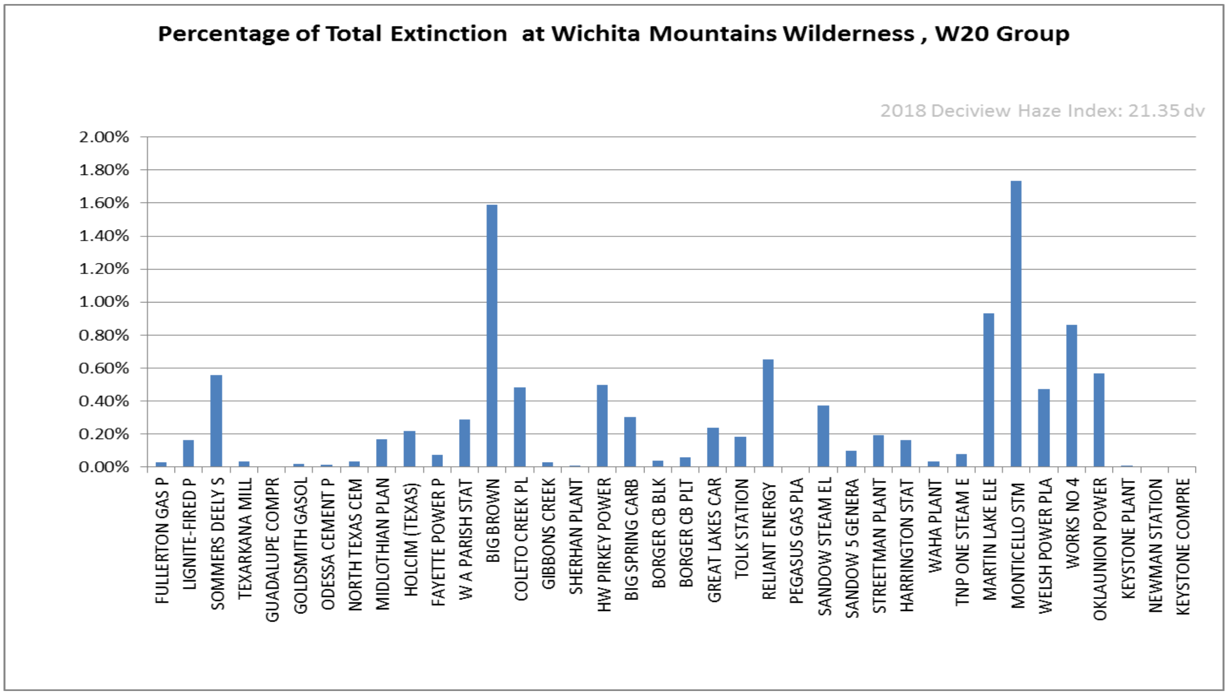


Figure A.2 -4. Percentage of Total Extinction by Species over 20%Worst Days at WIMO, OK

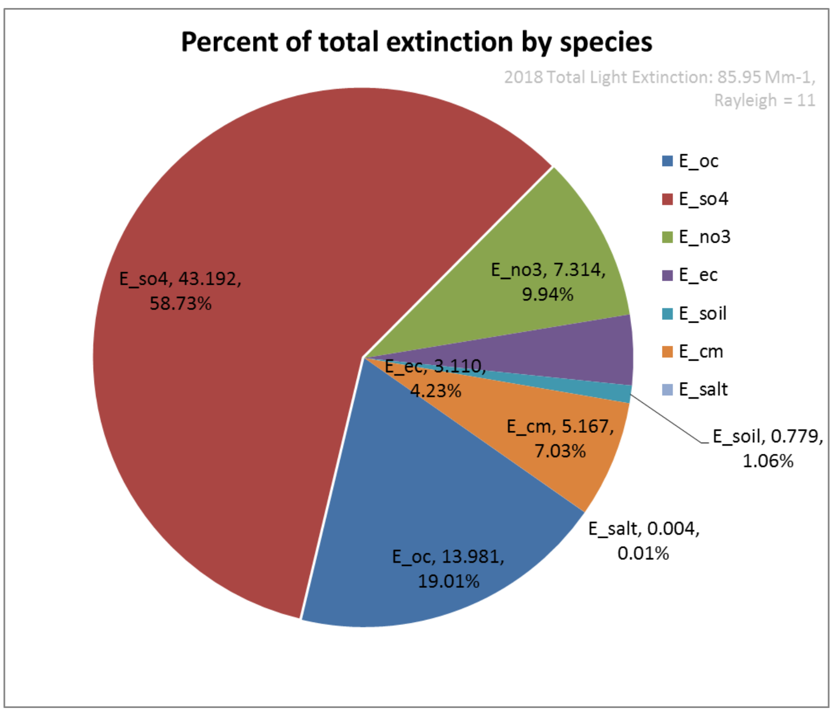


Figure A.2 -5. Maximum Source Contribution to 2018 Deciview on any day of W20% days at WIMO, OK

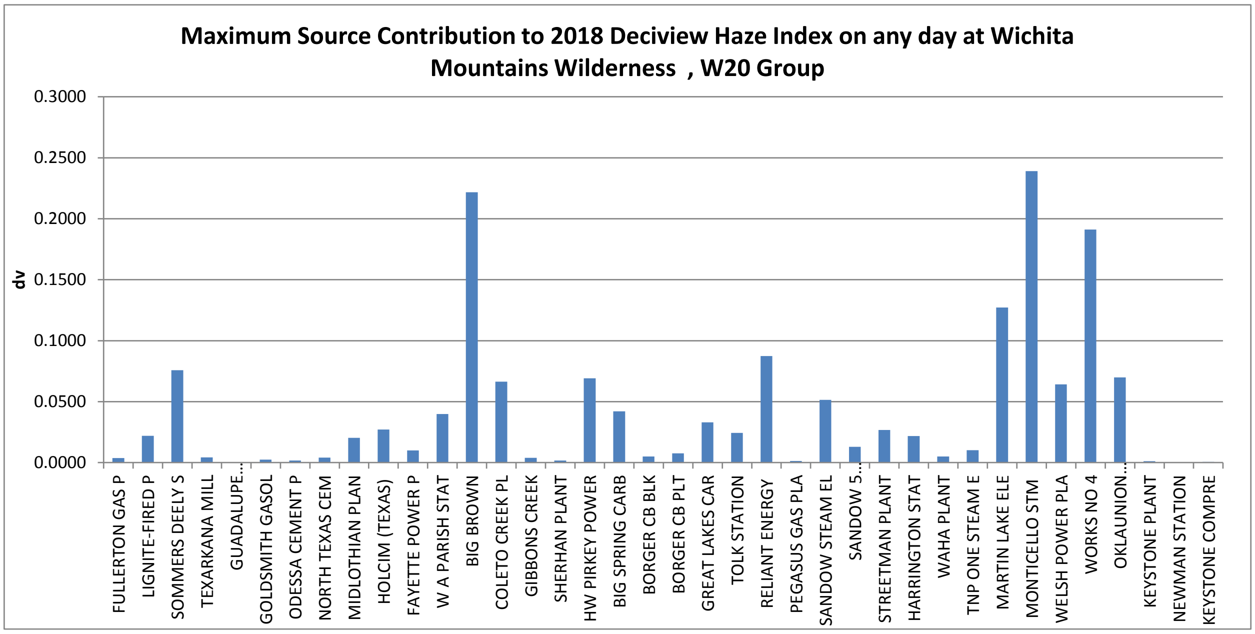


Figure A.2 -6. Uniform Rate of Progress and 2018 Projected Progress over 20%Worst Days at WIMO, OK

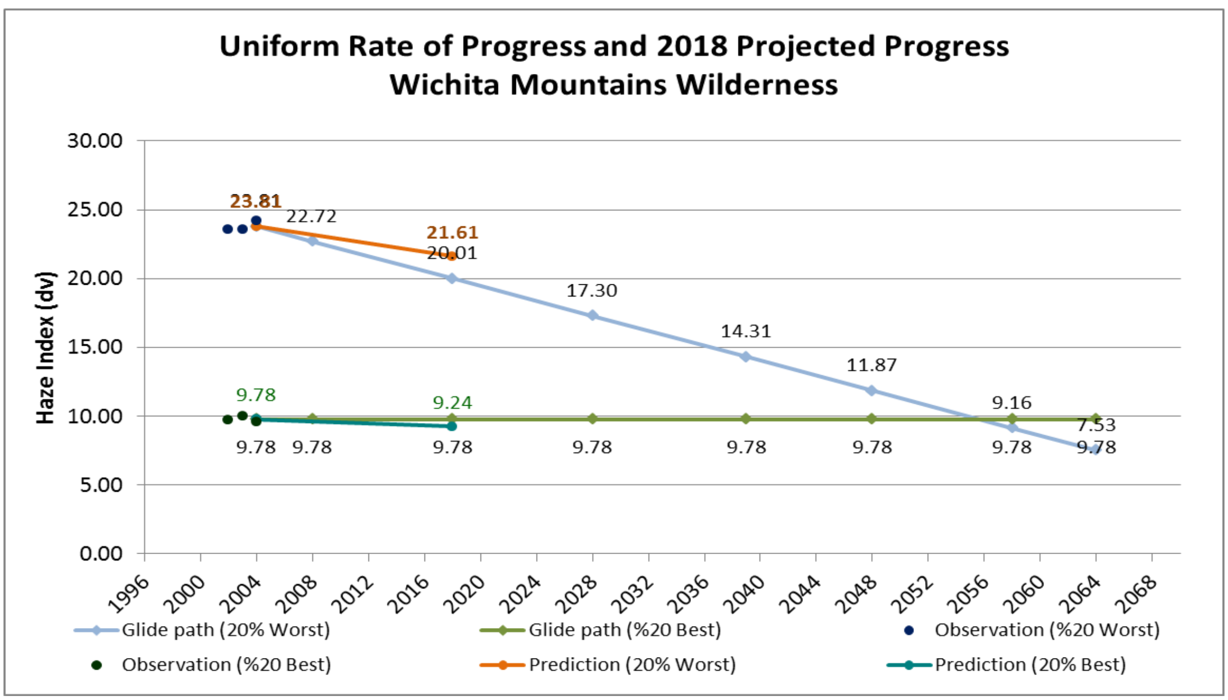


Figure A.2 -7. Source Contribution to 2018 Deciview over 20%Worst Days at BIBE, Texas

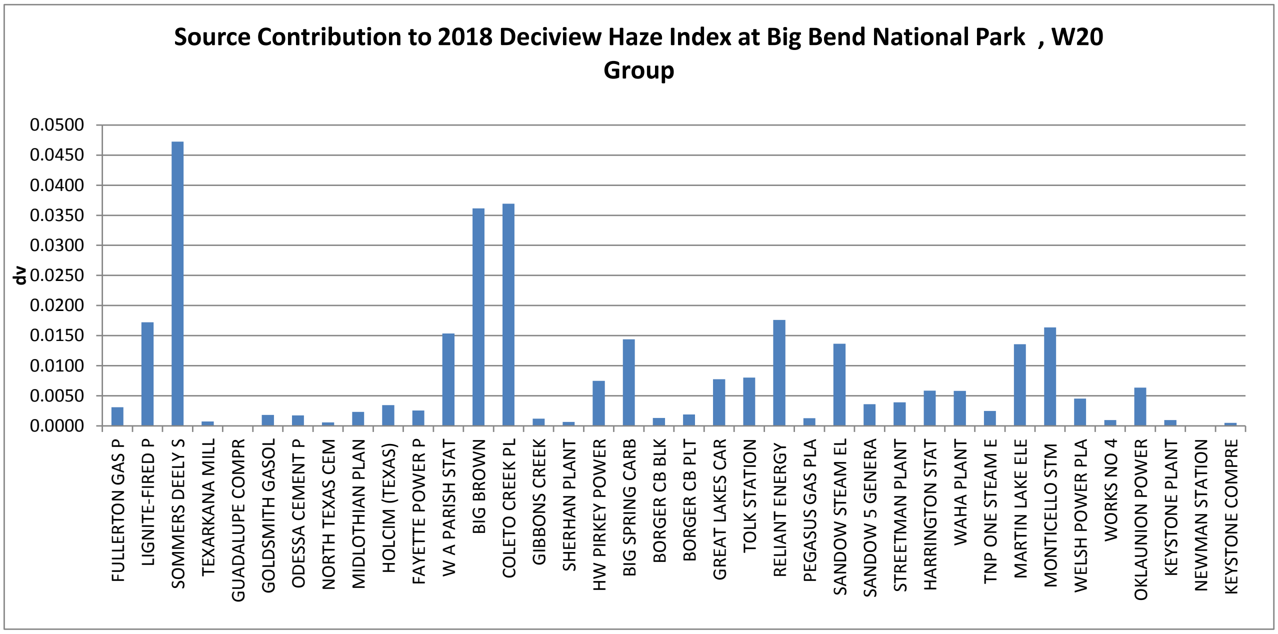


Figure A.2 -8. Source Contribution to 2018 Light Extinction by species over 20%Worst Days at BIBE, Texas

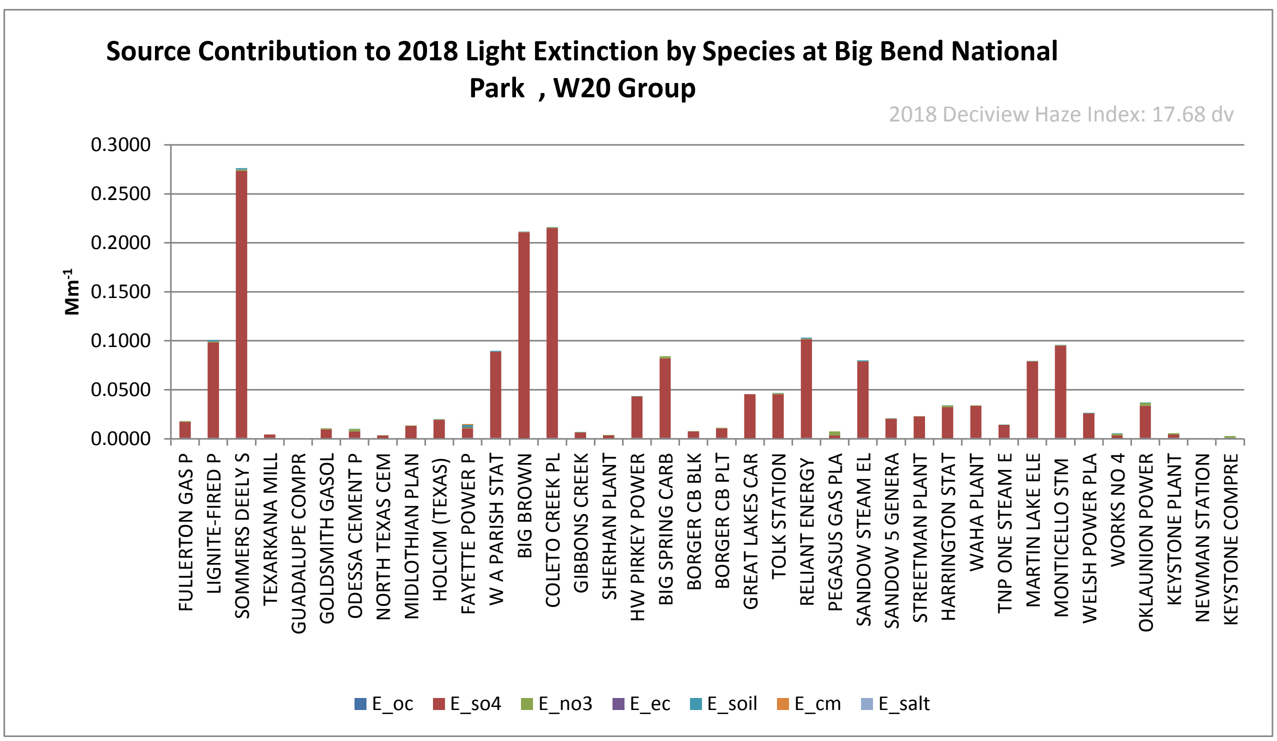


Figure A.2 -9. Percentage of Total Extinction over 20%Worst Days at BIBE, Texas

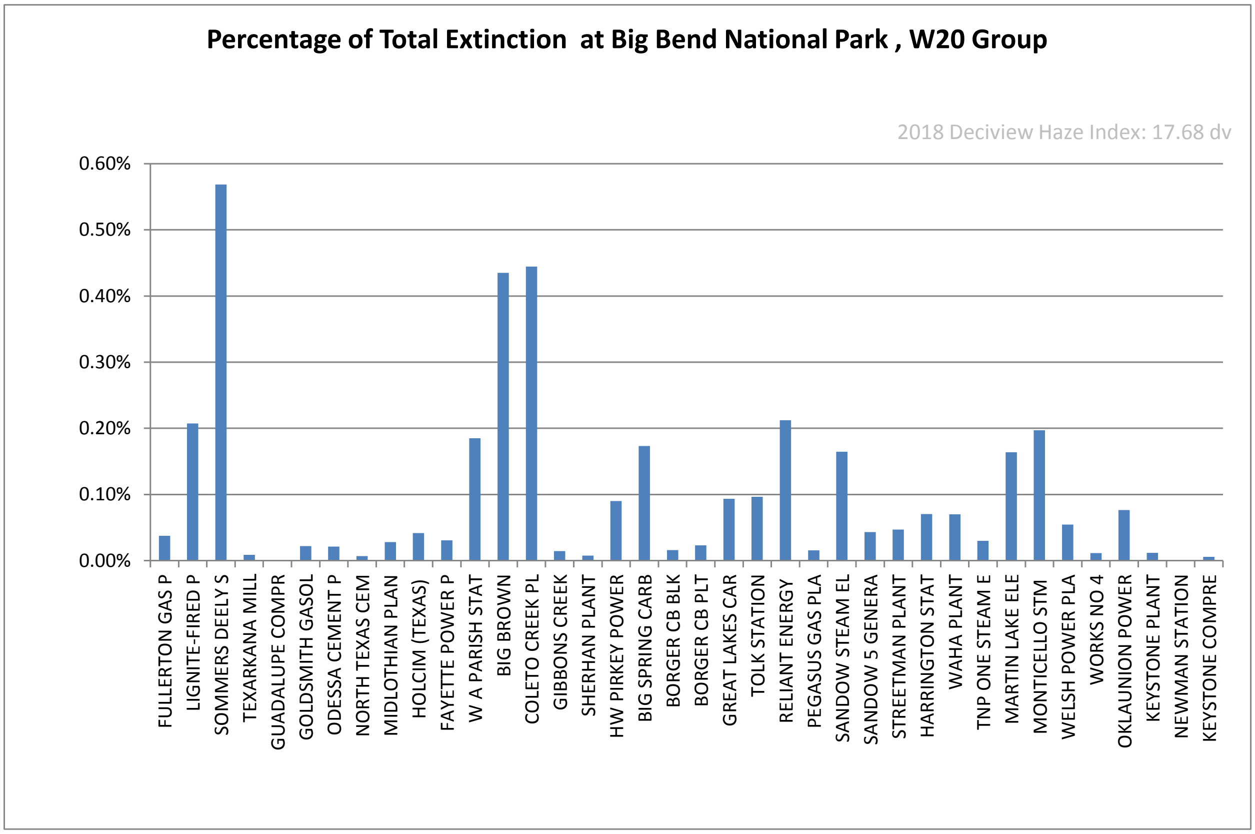


Figure A.2 -10. Percentage of Total Extinction by Species over 20%Worst Days at BIBE, Texas

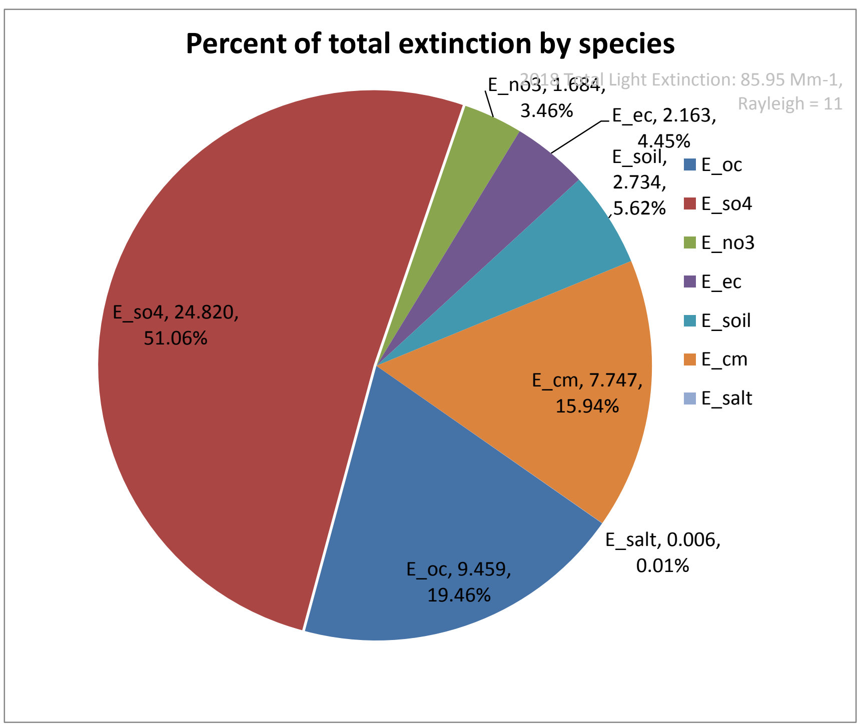


Figure A.2 -11. Maximum Source Contribution to 2018 Deciview on any day of W20% days at BIBE, Texas

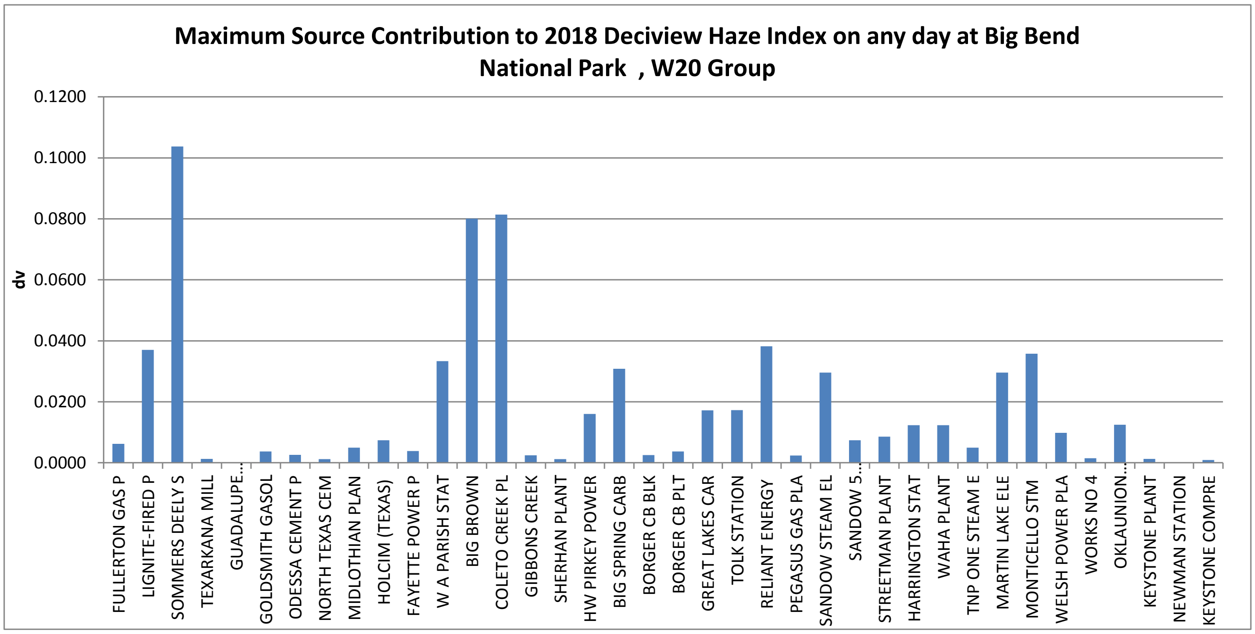


Figure A.2 -12. Uniform Rate of Progress and 2018 Projected Progress over 20%Worst Days at BIBE, Texas

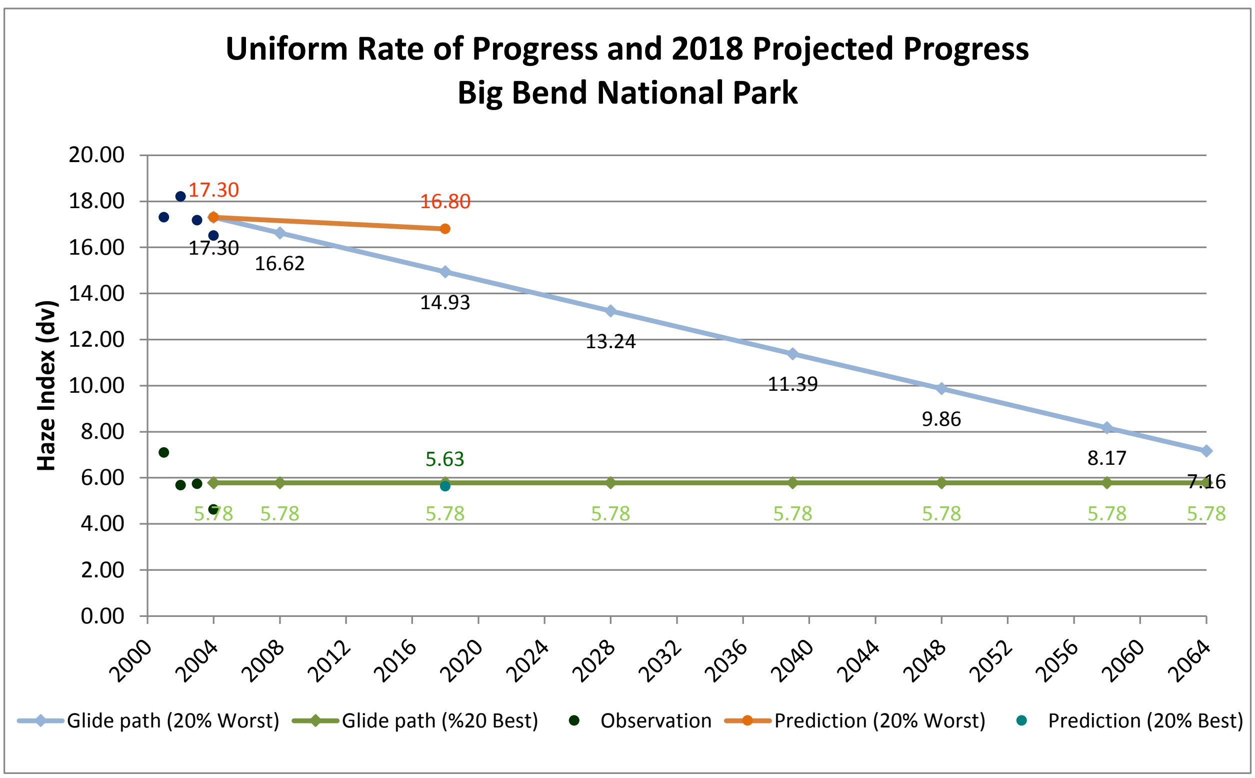


Figure A.2 -13. Source Contribution to 2018 Deciview over 20%Worst Days at GUMO, Texas

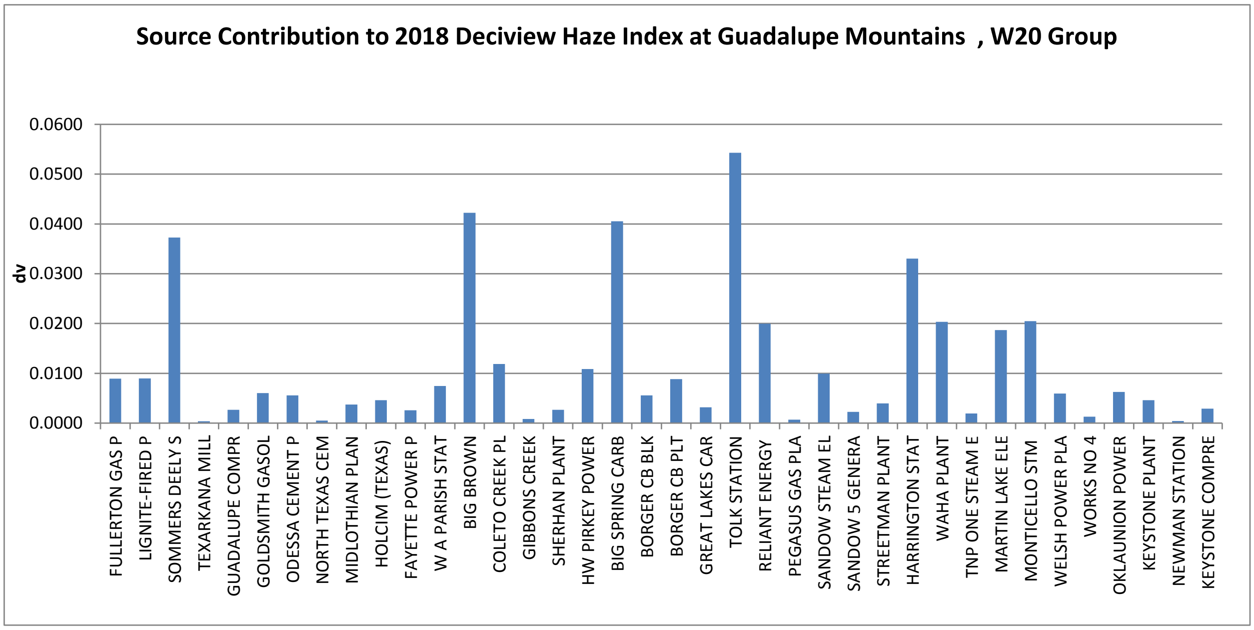


Figure A.2 -14. Source Contribution to 2018 Light Extinction by species over 20%Worst Days at GUMO, Texas

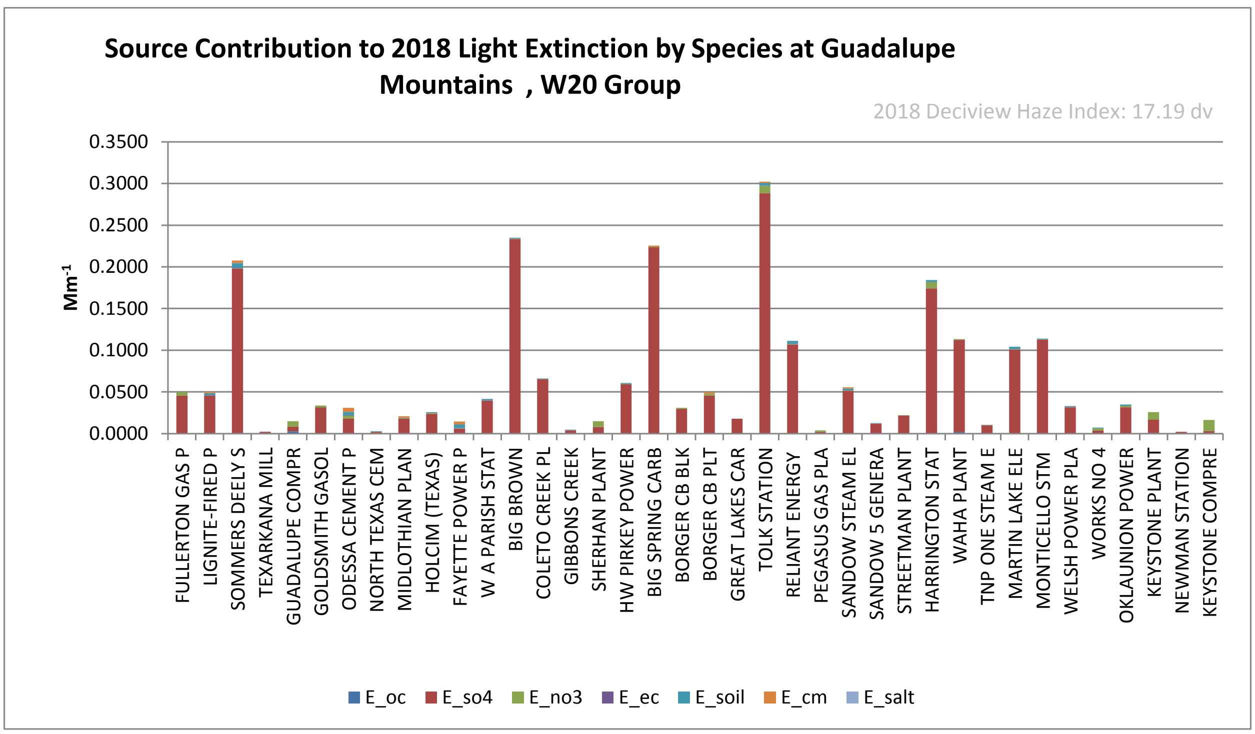


Figure A.2 -15. Percentage of Total Extinction over 20%Worst Days at GUMO, Texas

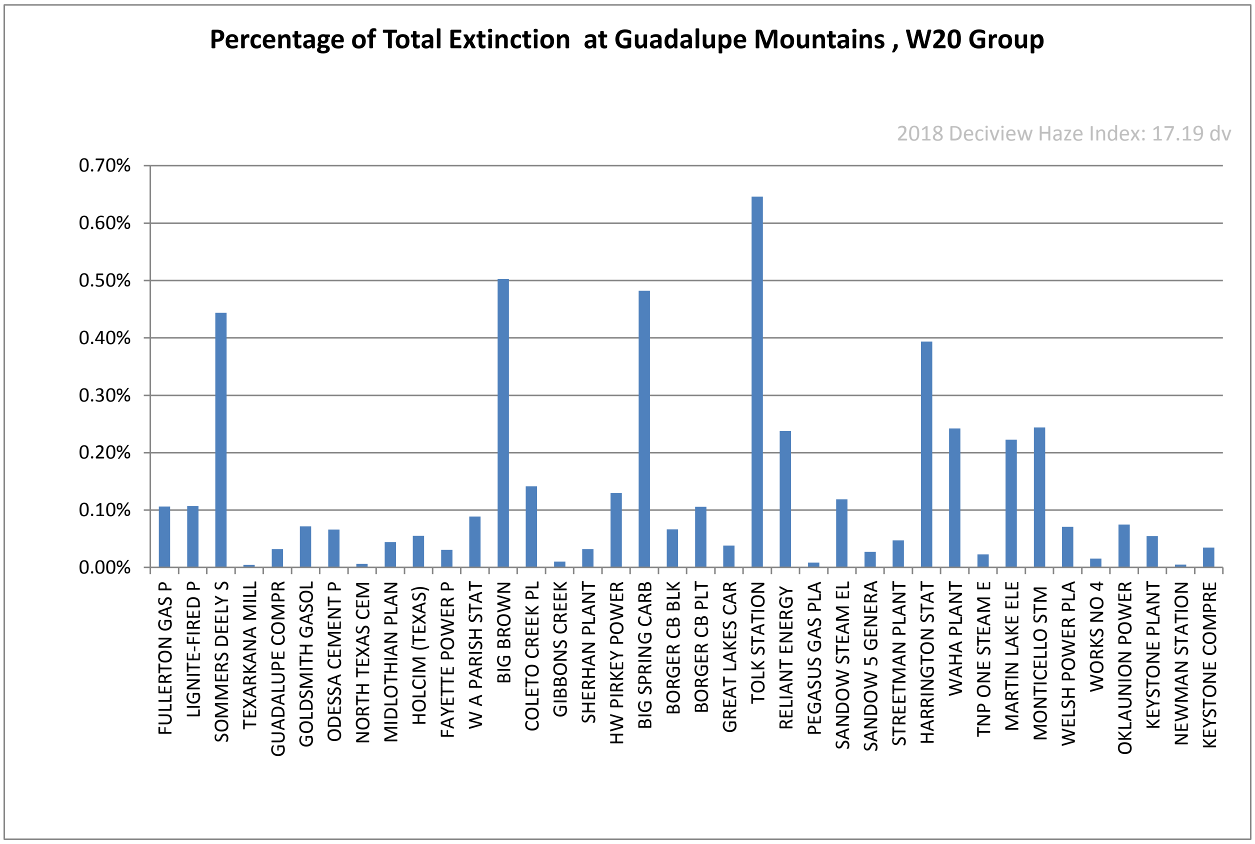


Figure A.2 -16. Percentage of Total Extinction by Species over 20%Worst Days at GUMO, Texas

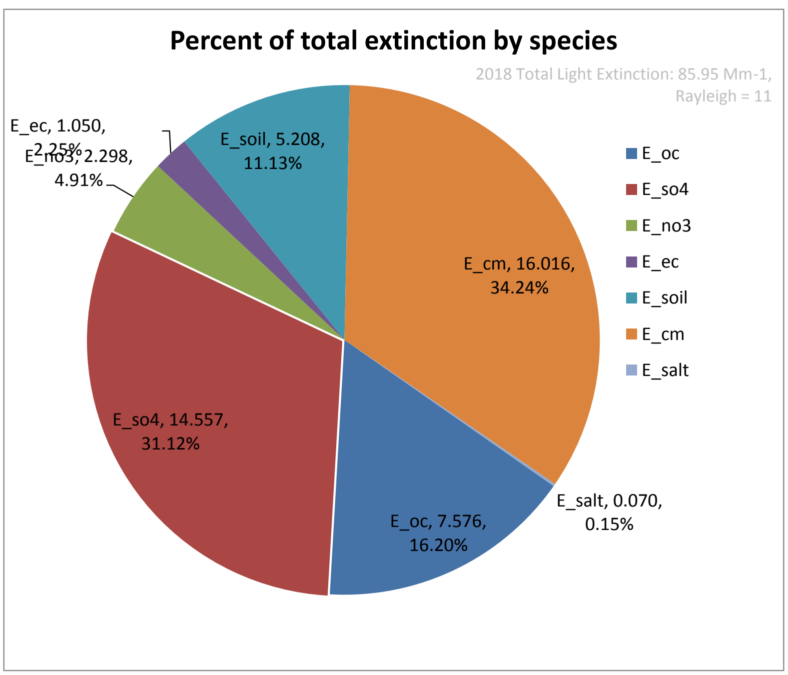


Figure A.2 -17. Maximum Source Contribution to 2018 Deciview on any day of W20% days at GUMO, Texas

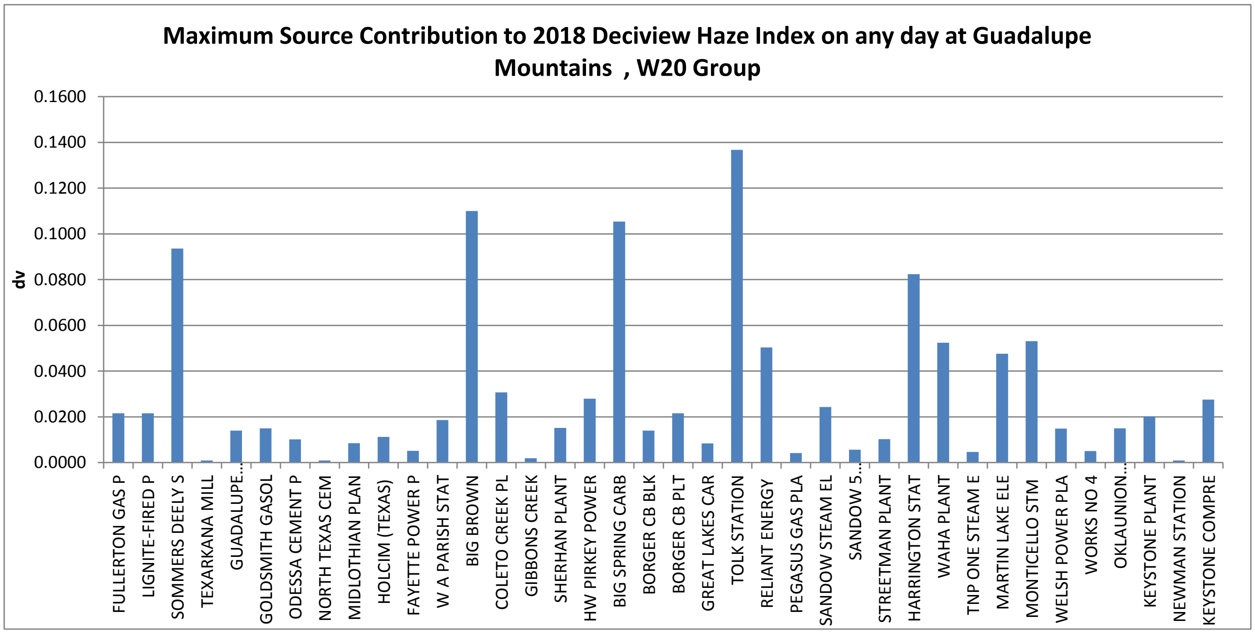
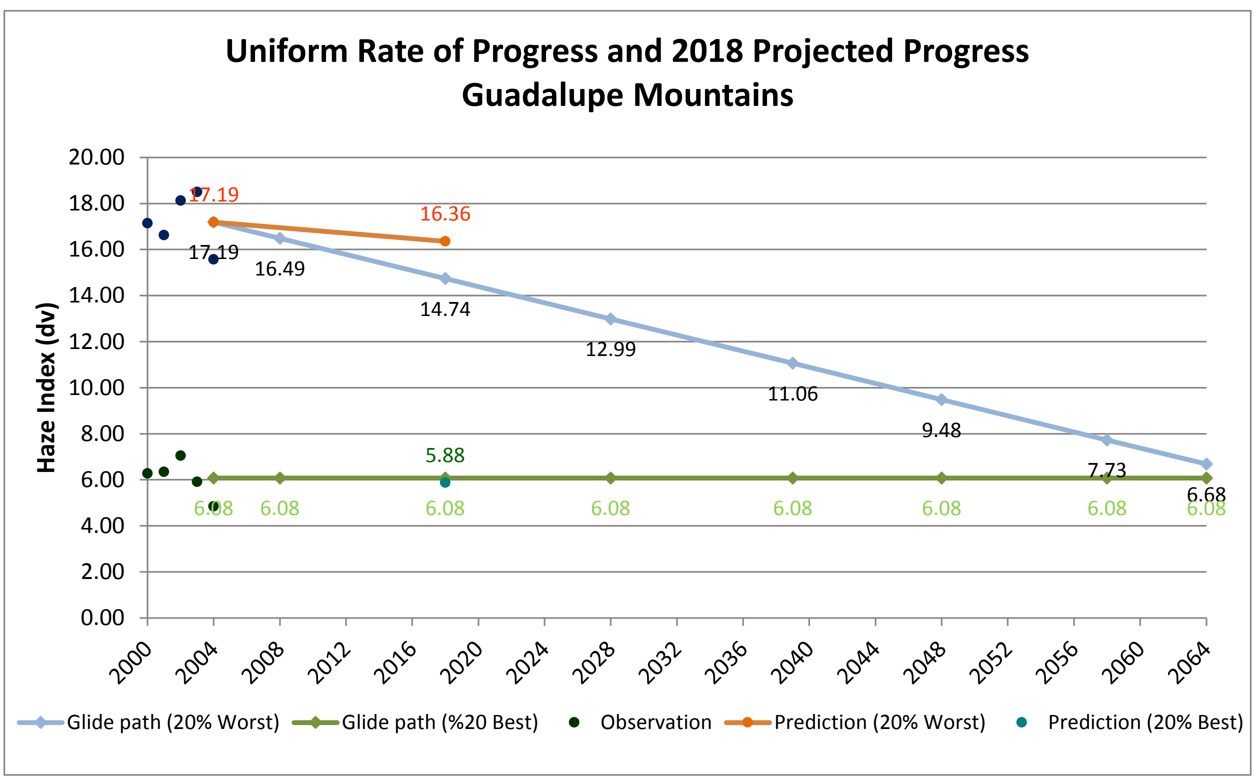


Figure A.2 -18. Uniform Rate of Progress and 2018 Projected Progress over 20%Worst Days at GUMO, Texas



A.3 Our Evaluation of Modeling for 38 Facilities

2018 Modeling Contribution Assessment

One of our points of inquiry was how much of the total impacts from Texas point sources is due to these 38 facilities, considering Texas had over 1,600 facilities in their point source database that we used in our Q/D analysis. We did not ask ENVIRON to redo the state level source apportionment modeling that was previously conducted by CENRAP for the 2018 Base G emission inventory in 2007, however, because we only made small changes to that inventory along with the modeling updates, we were able to do some comparisons to the original source apportionment results. As part of this work we did review and summarize some of the CENRAP source apportionment modeling results from late summer 2007.[35] We combined the impacts from the three regions of Texas from CENRAP's modeling (shared during consultation in 2007) that concluded that Texas is responsible for approximately 27.5% of the total impairment at WIMO and slightly over half of this (14%) total impairment was due to Texas Point Sources. See Figure A.3-1a-c for CENRAP PSAT information for WIMO, BIBE, and GUMO. Figures in Section A.2 includes the speciated extinction analysis from the PSAT modeling of the 38 facilities at WIMO and the two Texas Class I areas BIBE and GUMO from ENVIRON's recent work for us. Information for the other Class I areas evaluated in this study can be reviewed in electronic file using the look-up tables.[36] From the Figures and other information it is clear that most source impacts on the W20% days are dominated by impacts due to SO_2 emissions with the exception of some of the closer sources to the Class I areas (such as the Glass Plant in Wichita Falls {Works #4} and WIMO).

In comparison to the original CENRAP modeling PSAT work, we estimated that approximately 75-80% of the impacts from Texas Point Sources were from this small group of 38 facilities for the W20% days at WIMO.[37] See Figure A.3-2 for individual percentage contributions based on 2018 base case modeling. Similar analyses were also done for Texas Class I areas BIBE and GUMO. CENRAP's modeling indicated that 22.8% of the total impairment at BIBE was due to Texas and 8% (less than 1/3 of Texas' impacts) were from point sources on W20% days. The 38 sources are approximately 50% of this 8% that represents all Texas point sources impairment at BIBE. CENRAP's modeling also indicated that 34.6% of the total impairment at GUMO was due to Texas and 8.6% (approx. 1/4 of Texas' impacts) were from point sources on W20% days. The 38 sources are approximately 50% of this 8.6% that represents all Texas point sources impairment at GUMO.[38] See Figure A.3-3 and A.3-4 for individual % contributions based on 2018 base case modeling.

In evaluating the data and Figures A.2 – 6, A.2-12, and A.2-18 it is clear that WIMO, BIBE, and GUMO are all still projected to be above the Glidepath point in 2018. Due to the minor changes

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[35] Included in docket the CENRAP 2007 PSAT database
[36] Included in the docket: "Extinction charts.xls" and "EPA_txbart3612k_Vis_2002_2018_PSAT_Projected_MSF_v5.xlsx"
[37] Ibid.
[38] Ibid.

in modeling, 12km flexinest grid, etc.; there are slight differences in the projected values but the conclusions are consistent with the original CENRAP work.

In evaluating the impacts from individual sources it can be seen that even a smaller set of sources make up the majority of the total impairment impacts from the 38 facilities at these three Class I Areas. Therefore, we concluded it was worth investigating whether the installation of cost effective controls on a small group of sources, out of the universe of sources in Texas, would result in a significant reduction in Texas' contribution to the visibility impairment at Class I areas.

Figure A.3-1a. CENRAP 2007 PSAT results % of extinction impacts at WIMO (W20%)

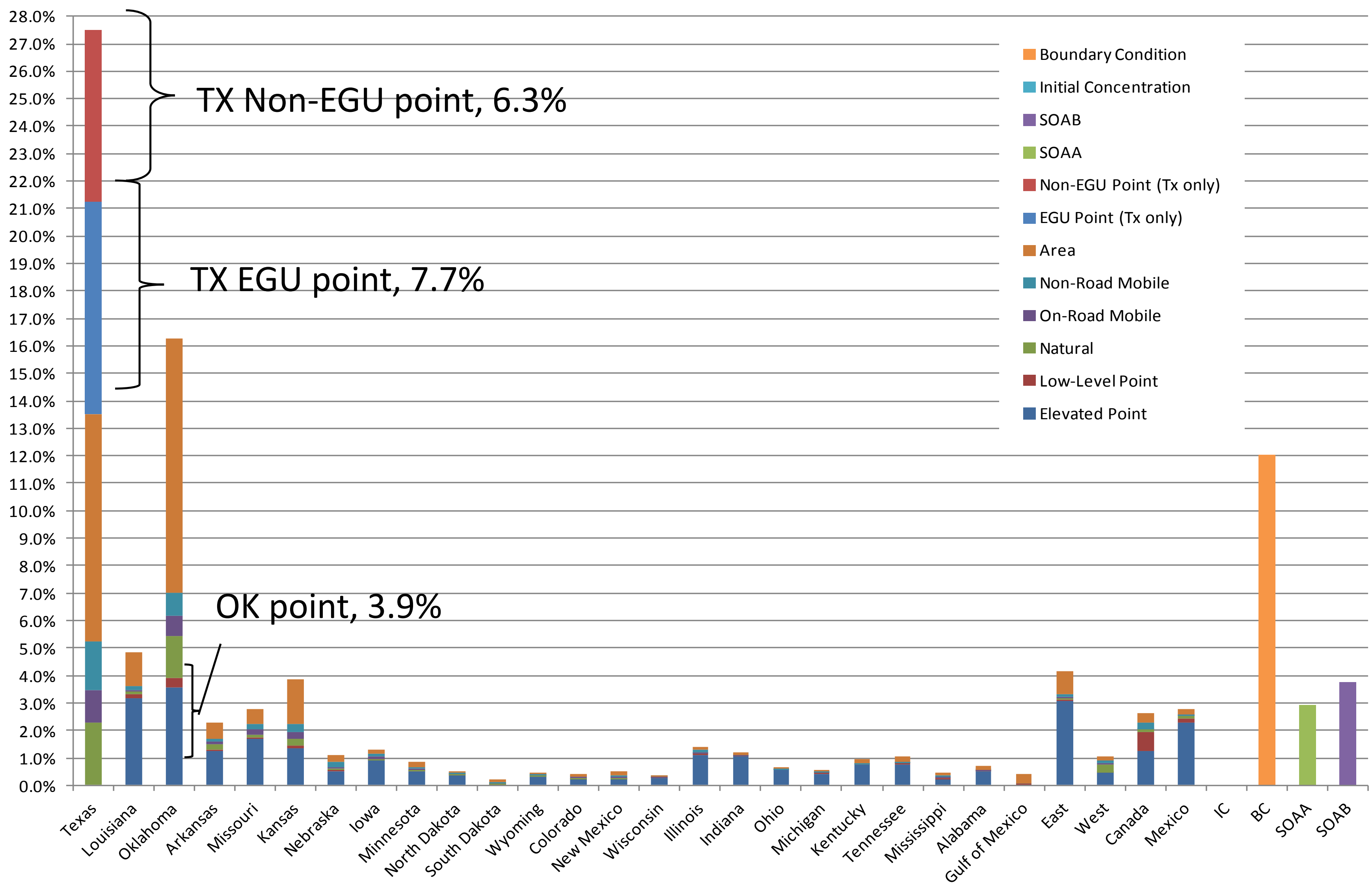


Figure A.3-1b. CENRAP 2007 PSAT results % of extinction impacts at BIBE (W20%)

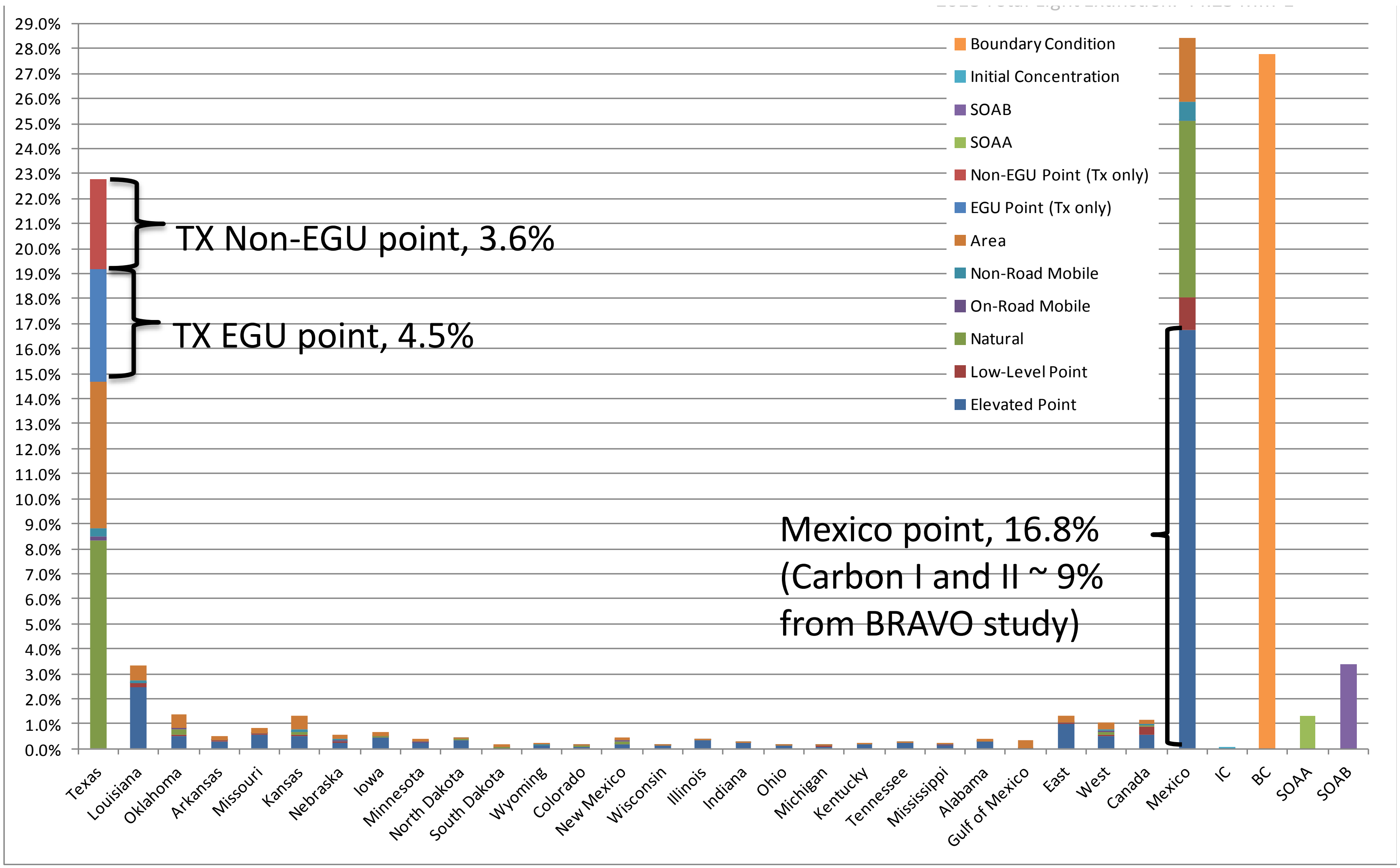


Figure A.3-1c. CENRAP 2007 PSAT results % of extinction impacts at GUMO (W20%)

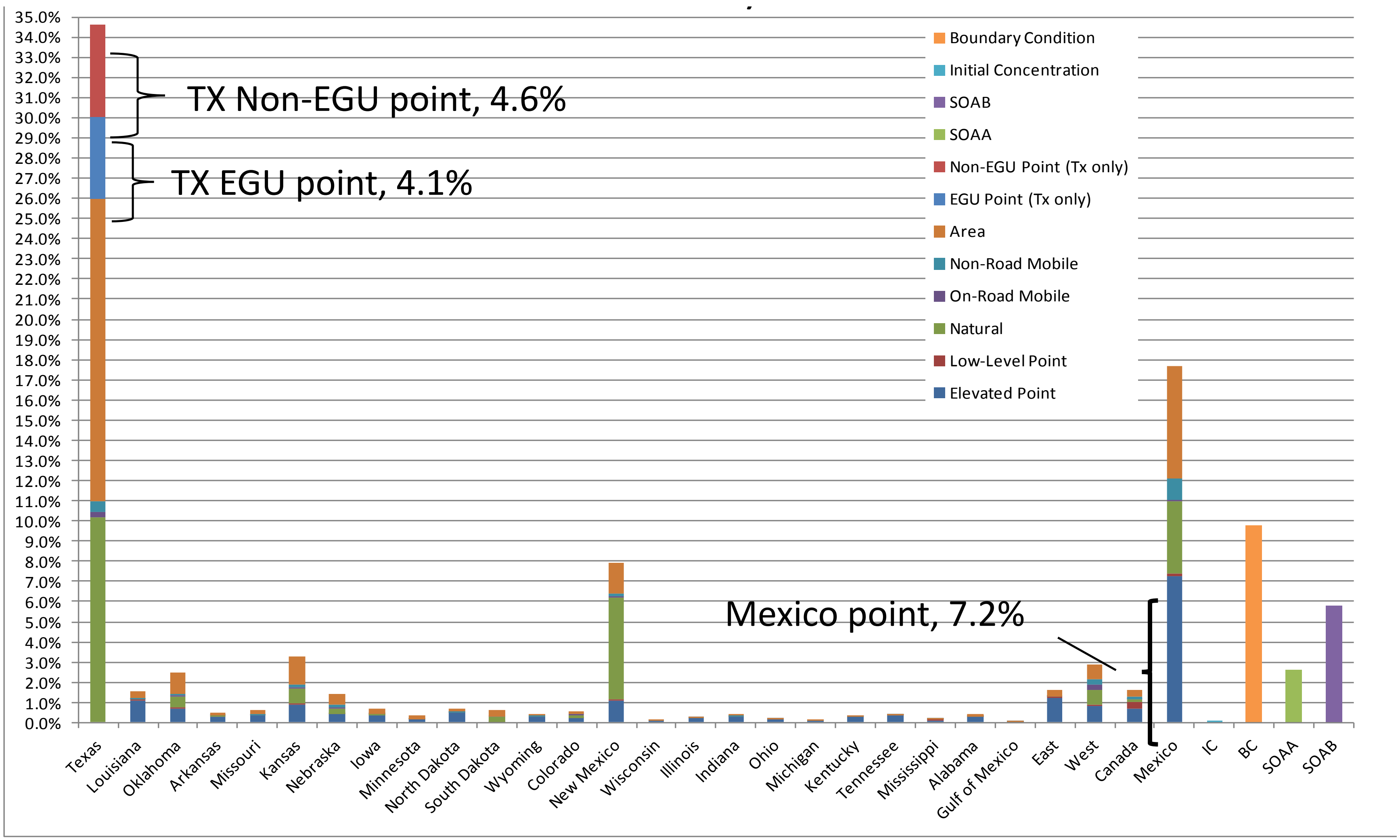


Figure A.3-2. Extinction Relative to Texas Influences and Texas Point Sources at WIMO (W20%)

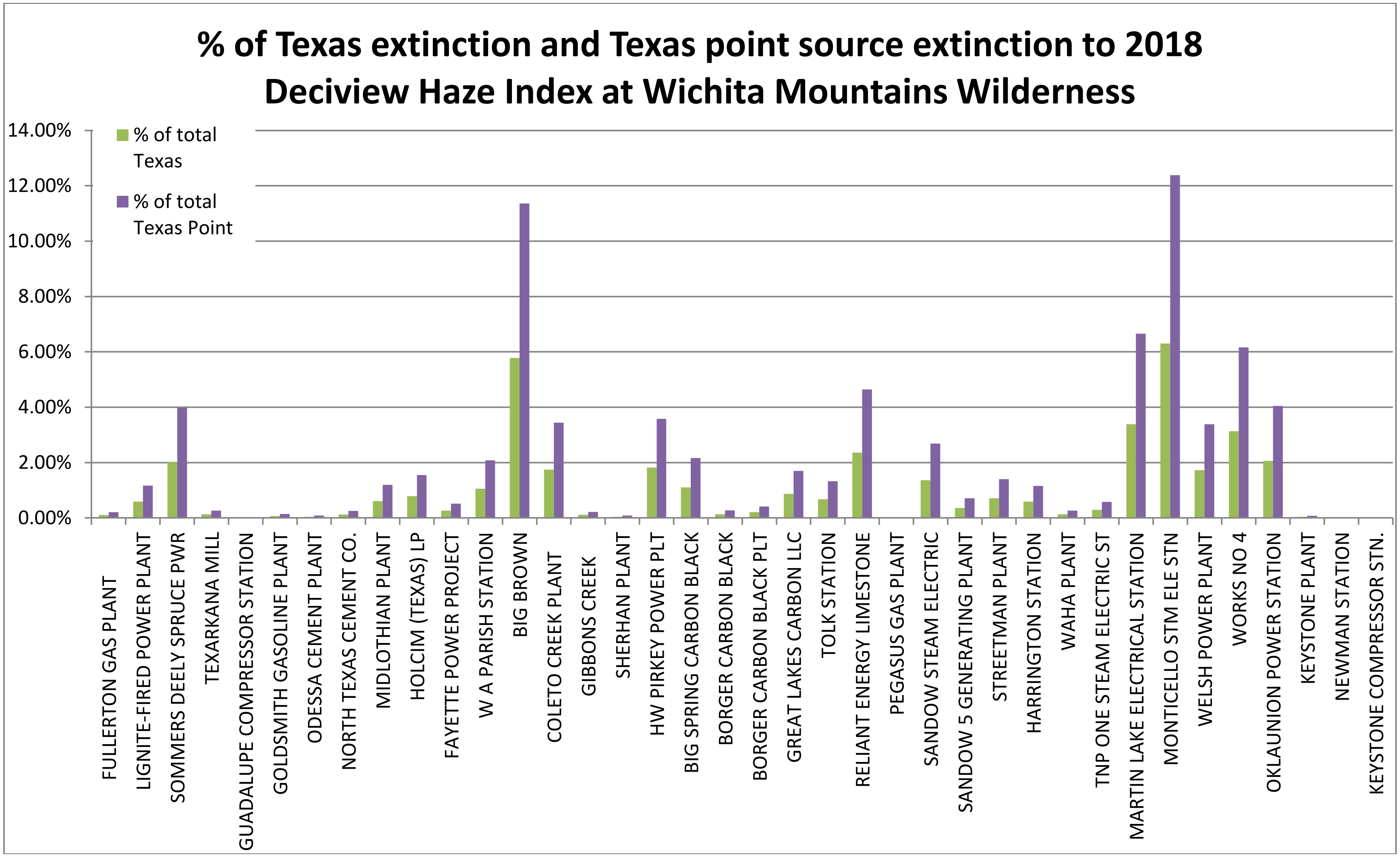


Figure A.3-3. Extinction Relative to Texas Influences and Texas Point Sources at BIBE (W20%)

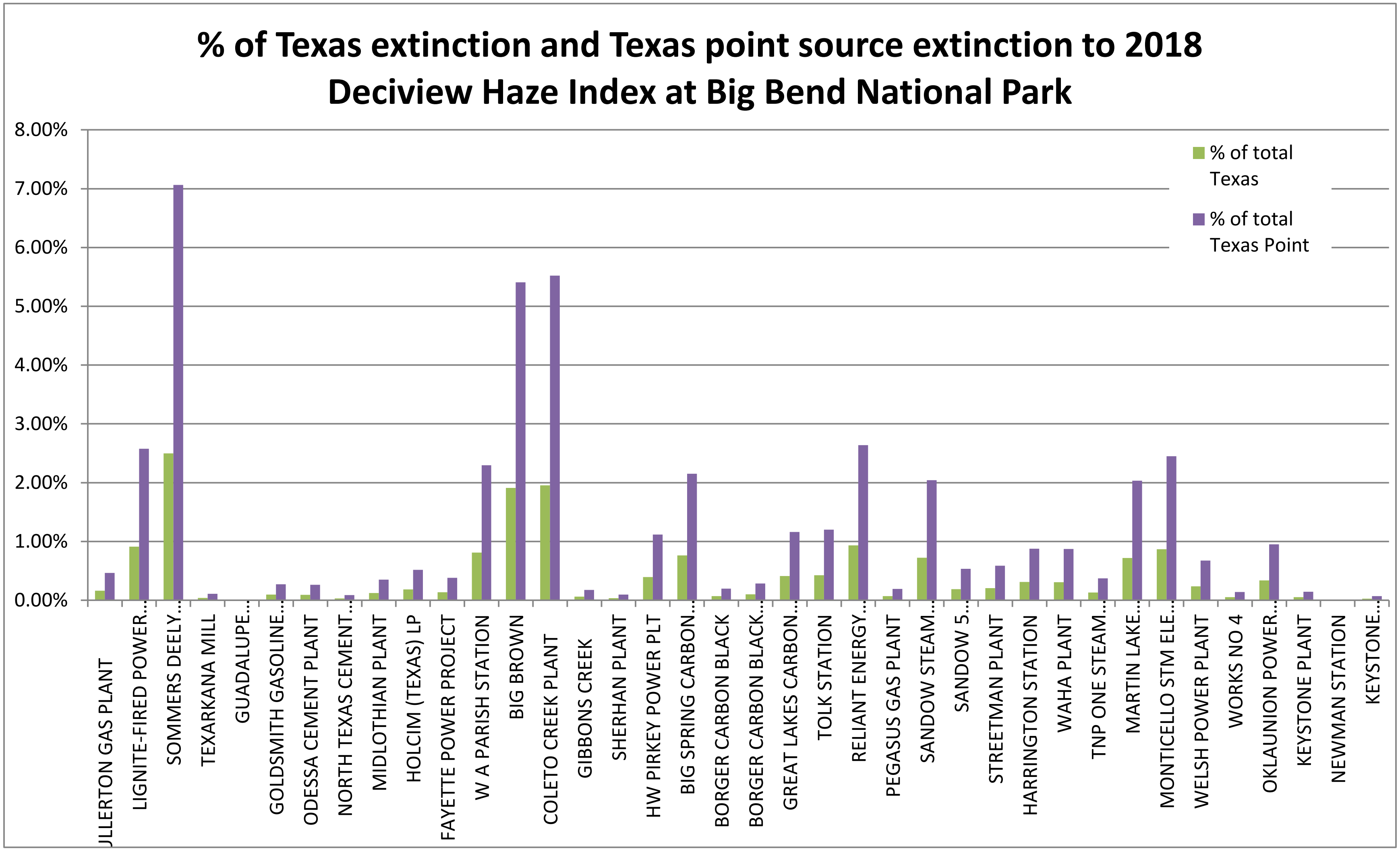
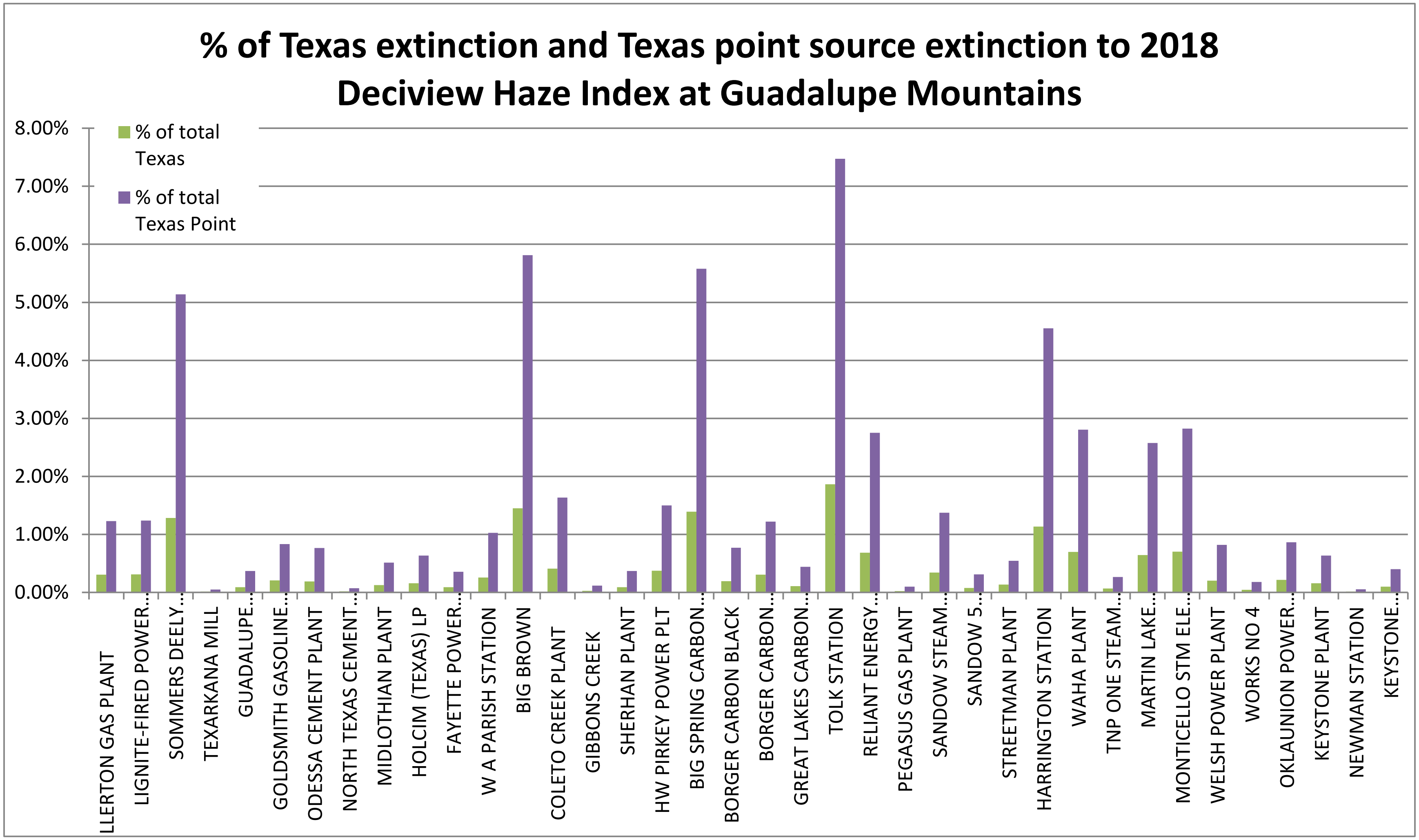


Figure A.3-4. Extinction Relative to Texas Influences and Texas Point Sources at GUMO (W20%)



Reasonable Progress vs. BART Analysis Issues

Our analysis has determined that a handful of the point sources in Texas (less than 1%) have a very large percentage of the contribution to visibility impairment at impacted Class I areas in a relative sense. However, difficulties arise when these modeled visibility impact levels from RP analysis using CAMx's photochemical modeling are compared to BART analysis using CALPUFF modeling for individual sources developed in support of other regional haze actions. We have not established specific metrics for use in evaluating single facility impacts on visibility impairment (RP) at downwind Class I areas with a photochemical grid model such as CAMx or CMAQ to help assess the significance of a modeled impact level, so there is a tendency to try to compare these modeled impacts to those metrics established for BART analyses with CALPUFF modeled results.. A common metric used in BART visibility modeling using CALPUFF is the BART screening level of 0.5 del-dv used by most states for screening out facilities from further BART consideration. However, there are a number of factors that make the two analyses uniquely different and not comparable, invalidating the use of the BART screening metric, or other such comparisons with modeled visibility impacts for RP with CAMx or CMAQ. Because of these many differences cause RP analysis results using CAMx to be much lower in magnitude than BART analysis results using CALPUFF. We highlight these differences below. We also discuss why BART analyses are addressing a fundamentally different question than the RP analyses, which makes BART and RP results not directly comparable.

***POLICY QUESTION DIFFERENCE* -** BART analyses are targeted towards assessing the impacts of a single facility's sources on Class I area(s) and result in ranked impacts based on the maximum or 98th percentile (also called High Eighth High and abbreviated as H8H) impacts of the facility independent of whether the Class I area was actually monitoring/modeling overall high visibility impairment on that day. Some of the highest impacting days from the source using CALPUFF for BART modeling could be days that overall visibility at the Class I area is not significantly impaired since CALPUFF does not conduct a full analysis of all emissions from all potential sources. RP modeling using a photochemical model (CAMx) typically evaluates impacts from a source (with all other sources also included in the modeling) on a Class I area's W20% and B20% days (days selected from monitoring that is cumulative of all emissions sources impacts at the Class I area) and is not looking for the maximum or near maximum impact of the specific source, but the average impact on these best and worst monitored days at a Class I area. Reasonable Progress modeling specifically assesses using these W20% and B20% days, so it would be difficult to deviate from these metrics in our review of the Texas and Oklahoma SIPs. Specifically, the BART based analysis (typically CALPUFF) is focused on finding the highest impact (max or H8H) from a facility regardless of the monitored values at the Class I area, whereas the RP analysis (typically CAMx/CMAQ) is focused on the 20% best and 20% worst monitored days regardless if the facility was having an impact during those days (20% equates to 72 days out of 365 days, IMPROVE monitors usually monitor 1 in 3 days so this would equate to 21 days). The metric evaluated is the facility's average impacts (not max or high distribution impact) for those 20% days identified by the monitor data. Therefore BART analyses are focused on answering a policy question of what is the maximum or 98th percentile impacts (365 days/year) of the facility being analyzed regardless of overall visibility impairment levels at the Class I area, and RP analyses are focused on assessing the average impacts of a facility on 20% of the days in the year with the Best and Worst overall visibility impairment days at the Class I area regardless of whether the facility had large/sizeable impacts on any of those particular days. In some situations, the days that BART modeling maximum or 98th percentile value impacts of the facility occur may not coincide with any of the days that make up the days in the Worst 20% days at the Class I area in a RP analysis.

***METRICS DIFFERENCE ISSUE* –** As mentioned above, because RP is using the average of the change in impacts from control on data representing up to the worst 72 days for total visibility impairment at the Class I area that were selected from monitored values in the base period, there is not a direct correlation that these days align with the days that a specific facility would impact a Class I area such as WIMO. Even if the worst 20% days based on monitoring (reflective of all pollutants in the air shed) did coincide with the 20% highest days from BART modeling with CALPUFF, there are still the fundamental differences between the metrics. BART modeling impacts with CALPUFF are based on running 3 years of meteorology and picking the 1st or 8th highest value of 365 data points for each year and then picking the highest of the three 1st or 8th highs. RP anlaysis with CAMx is using the 20% worst days for evaluation of a facility's impacts (worst days of visibility impairment monitored at the Class I area from all days and meteorological/transport conditions in the base period). When daily BART modeling with CALPUFF impacts ranked from highest to lowest were examined, typically the change would be closer to an exponential rather than a linear change, so the 1st or 8th high (BART metric) would be significantly higher than the average of the top 21 or 72 days impacts (RP impacts). RP metric results (average impact over the 20% worst days) could easily be several times less than the CALPUFF based BART metrics (1st or 8th high single day impact).[39]

***EMISSIONS ISSUE* –** BART screening modeling of a facility following the BART guidelines uses maximum 24-hour emissions (over a 3 to 5-year period) which are significantly higher than what we are using in the RP analysis (annual average tpy). Typically, when a facility lacked adequate data for maximum 24-hour actuals guidance that EPA Regional modelers provided (and states/sources followed) was to examine available data and double the annual average lb/hr rates in order to arrive at an estimate of maximum 24-hour actuals. For the few cases where BART screening was done with CAMx, including the Texas BART screening with CAMx, the same multiplier of 2X annual average lb/hr in the CAMx modeling was used.[40] Due to this issue alone it is reasonable to conclude that the RP results using annual actual emissions would be 50% lower than BART modeling results as the CAMx modeling has shown a linear relationship with extinction levels and emissions changes.

Several of the EPA Regions, including we in Region 6, analyzed some of the available CEM data, utilization rates, and other information at the time (2004-2005) to support the 2 X multiplier of the annual average emission rate to estimate 24-hour max actual emissions (lb/hr) and states agreed with this approach for BART screening. To further support this approach for this action we also looked at recent modeling we in Region 6 have done in our Oklahoma FIP. In our BART modeling with CALPUFF used to evaluate benefits of controls, we used 80/85% load factor for the Muskogee Units 4 & 5 respectively, although some modeling elsewhere has used higher values for modeling control benefits. Actual load factors vary but were more often in the 60-75% range. In BART analyses, we modeled the emissions for 8760 hours and not based on

[39] Included in Docket "OK CALPUFF distribution results.xlsx".

[40] Page 2-10 Screening Analysis of Potential BART-Eligible Sources in Texas; "App9_5_rev.pdf"

actual hours of operation. The actual BART Baseline (pre-control) was based on the historical range of coal burned and the lb of SO_2/MMBTU was 0.8/0.85 respectively for Units 4 & 5. This equated to annual SO_2 emissions for the Baseline BART modeling of 19,202 tpy for Unit 4 and 20,402 tpy for Unit 5. These units have switched to a lower sulfur content coal since they were burning the higher sulfur content coal in the early 2000s and recent actuals are much lower. Using SO_2 emissions data based on CEM data (2009-13 annual actuals based on CEM data and then dropping the min and max years values and averaging the three remaining years), Muskogee Units 4 and 5 values are 7,687 tpy, and 8,093 tpy. These emissions are less than half of the value used as the baseline for estimating the benefits of controls for BART using CALPUFF in the OK FIP. Although each situation will be different, we believe this, and the multiplier of 2X actuals used in the screening, both support that RP results using the same metrics would be 50% or less than the BART based results just due to the differences in emissions modeled for a facility.

CHEMISTRY ISSUE – CALPUFF uses a rather simple chemistry mechanism and CAMx uses a significantly more complex chemistry mechanism. It is unclear how this ultimately impacts the model estimates between these two models as the two chemistry approaches are vastly different. The more technically sophisticated CAMx model's chemistry provides many more reactions and alternate pathways for regional haze pre-cursor emissions to be consumed/reacted, but given all the differences in the chemistry mechanisms, pre-cursor concentrations, and other differences that would introduce variation in comparisons it is impossible to come up with an answer on how this issue should be factored into a comparison of model results from CAMx and CALPUFF except to conclude that they would likely give differing values.

We considered the above issues in deciding to employ CAMx for our analysis. Since the RP analysis is based on W20% and B20% and is typically evaluated with a photochemical model such as CMAQ or CAMx in most states RH SIPs including Texas and Oklahoma, we believe it is appropriate to conduct this analysis with a photochemical model. EPA's guidance does recommend photochemical models for RP analyses over great distances. We also factored in that many of the sources being evaluated are beyond the typical range of 300- 400 km from a Class I area and at greater distances raising some concern that CALPUFF may be over-predicting or not as accurate. CAMx also gave us the capability of doing PiG with chemistry in the PiG and also full source apportionment. Therefore we chose to complete our analysis with CAMx and its available tools.

"CLEAN VS. DIRTY" BACKGROUND ISSUE- CALPUFF modeling (for BART and other analyses) is conducted to determine a facility's impact on a Class I area with no consideration of other pollutants in the air (other than natural background conditions) to challenge and consume the pre-cursors that are modeled to react with the facility's emissions. Because the ammonia and other pollutants are more fully available to react with the facility's emissions and generate haze causing pollutants in a CALPUFF analysis, this is often termed a 'clean background' analysis. CAMx is a full photochemical model with all the other sources quantified and added to the modeling, such that emissions from other facilities, non-point sources, mobile sources, etc., all react with available pre-cursors such as ammonia. This limits the amount of ammonia (and other pre-cursors) that are available to react with the specific facility emissions that is being assessed. Because CAMx takes into account the entire pollution load in the atmosphere in 2018, we often refer to this as the "dirty background" analysis. A facility's visibility impairment impacts are substantially lower with a dirty background analysis compared to a clean background analysis. The new Improve equation is used to calculate the extinction (Inverse Megameters) that is then converted to del-dv using a logarithmic relationship. This logarithmic relationship is dependent upon the point on the deciview-extinction curve where the analysis is completed. For example, see Figure A.3-5 which shows the del-dv change due to a 10 (1/Mm) change at both the 2018 projected extinction level and the 2064 natural visibility conditions extinction level for the Wichita Mountains. In the 'dirty background' case the 10 (1/Mm) yields a 1.26 del-dv, whereas in the 'clean background' case the same 10 (1/Mm) yields a 3.86 del-dv improvement. In this example, the 'clean background' situation yields a del-dv improvement 3 times greater than the 'dirty background' for the same level of extinction improvement. In the context of evaluating potential controls for a source, both of these are important since any emission reductions in 2018 from controls will continue to provide benefits as other pollutant concentrations decrease in the Class I area atmosphere which results in further reductions in the calculated extinction levels (using the new IMPROVE equation) and therefore yielding more del-dv benefit over time as the area approaches natural condition levels.

The 'clean' vs. 'dirty' background issue can be conceptualized in an analogy by realizing that the deciview scale of visibility is similar to the decibel scale of sound. If a pin is dropped on a table in a quiet room (analogous to a clean background CALPUFF run), it can be easily heard. If on the other hand, the same pin is dropped on the same table in a noisy room (analogous to a dirty background CAMx run), it will not seem as loud in a relative sense. In both cases, the dropped pin makes the same sound (analogous to extinction level), but in the latter case, that sound is partially obscured by the noisy room.

In the BART Rule, we wrote:[41]

> Using existing conditions as the baseline for single source visibility impact determinations would create the following paradox: the dirtier the existing air, the less likely it would be that any control is required. This is true because of the nonlinear nature of visibility impairment. In other words, as a Class I area becomes more polluted, any individual source's contribution to changes in impairment becomes geometrically less. Therefore the more polluted the Class I area would become, the less control would seem to be needed from an individual source. We agree that this kind of calculation would essentially raise the "cause or contribute" applicability threshold to a level that would never allow enough emission control to significantly improve visibility. Such a reading would render the visibility provisions meaningless, as EPA and the States would be prevented from assuring "reasonable progress" and fulfilling the statutorily-defined goals of the visibility program. Conversely, measuring improvement against clean conditions would ensure reasonable progress toward those clean conditions.

In evaluating benefits of potential controls in our analysis, we considered estimated deciview improvements based on both a degraded 2018 background and a "clean" background based on average annual natural conditions, as shown in the tables below. As discussed above, since our analysis is based on a full photo-chemical grid model that includes modeling all emissions in the

[41] 70 FR 39124

modeling domain, the model results are inherently a degraded background analysis and the results are impacted/lowered by emissions from other sources in our 2018 analysis. To estimate the full benefit of reductions on a source we have estimated the natural conditions to simulate “clean” background results based on the modeled extinction impact levels for each source and calculated the del-dv based on annual average natural conditions. Due to the inclusion of all these other sources at 2018 estimated emission levels, the estimated impacts from a source (or from controlling a source) are less than the results that would be obtained using emission levels of sources that would exist when natural conditions are achieved. We note that CALPUFF based modeling simulates ‘clean’ background conditions with no other sources included than the source(s) being evaluated. The deciview improvement based on the 2018 background conditions provides an estimate of the amount of benefit that can be anticipated in 2018 and the impact a control/emission reduciton may have on the established RPG for 2018. However, this estimate based on degraded or “dirty” background conditions underestimates the visibility improvement that would be realized for the control options under consideration. Because of the non-linear nature of the deciview metric, as a Class I area becomes more polluted the visibility impairment from an individual source in terms of deciviews becomes geometrically less. Results based solely on a degraded background, will rarely if ever demonstrate an appreciable effect on incremental visibility improvement in a given area. Rather than providing for incremental improvements towards the goal of natural visibility, degraded background results will serve to instead maintain those current degraded conditions. Therefore, the visibility benefit estimated based on natural or “clean” conditions is needed to assess the full benefit from potential controls. In our final decision for our North Dakota SIP and FIP,[42] we explained this by noting:

> This is true because of the nonlinear nature of visibility impairment. In other words, as a Class I area becomes more polluted, any individual source's contribution to changes in impairment becomes geometrically less. Therefore the more polluted the Class I area would become, the less control would seem to be needed from an individual source.

We were subsequently upheld on this point by the Eighth Circuit Court in North Dakota v. EPA. 730 F.3d 750, 766 (8th Cir. 2013).

We have also considered this natural condition approach in other actions, such as Wyoming.[43]

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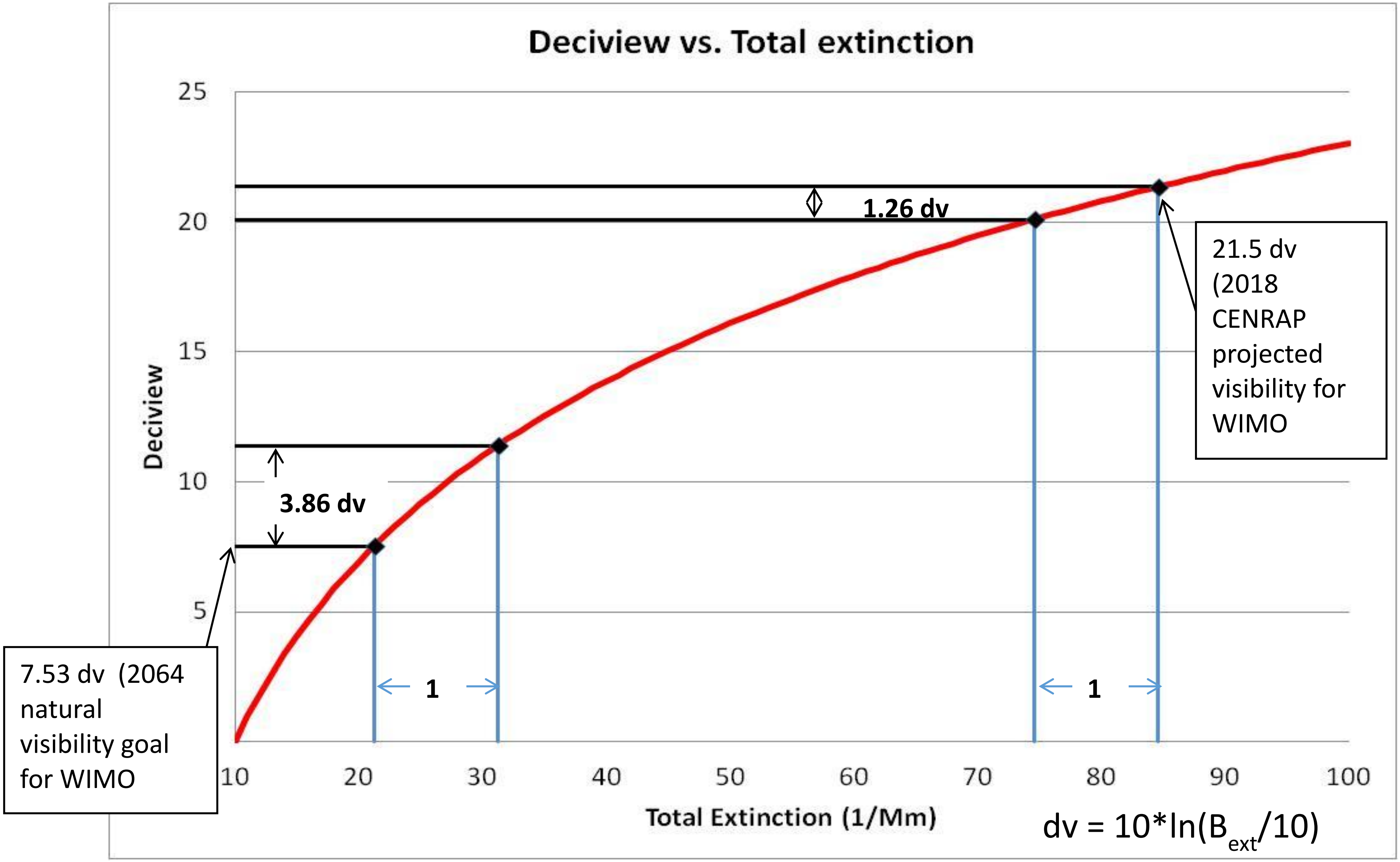
[42] 77 FR 20912.
[43] 77FR 33022-62, 78 FR34738-34794, 79 FR 5032-5222.

Figure A.3-5. Example of Logarithmic nature of del-dv calculation



A.4 Modeling Results – Selection of Sources for Further Evaluation

After our initial evaluation of modeling results from ENVIRON, we decided to examine the results in several different ways to help in identifying a subset of sources for further visibility modeling and control analysis. This second round of analysis was focused on looking at the largest impacting sources at WIMO, BIBE, and GUMO from the initial analysis and will be discussed further in Section A.5. This section will explain how we selected the subset of sources for further evaluation.

IDENTIFICATION OF THE TOP 10 IMPACTING FACILITIES

We initially evaluated and ranked the top 10 impacting facilities for each of the three Class I areas. These Tables are included in Tables A.4-1a-c and include the average extinction on the 20% Worst Days and also the maximum extinction during the 20% worst days. This information is provided in units of Inverse Megameters (1/Mm) and as percent of total extinction (avg. 20%W). In comparing results between the Class I areas we provided the percent approach to somewhat normalize the total extinction differences between the differing Class I areas. For example, with regard to the clean vs. dirty background issue we discussed above, we consider a 10 (1/Mm) extinction on a cleaner background area such as GUMO which has a relatively lower total extinction level more beneficial than a 10 (1/Mm) extinction at WIMO which has a much higher total extinction level. As we discussed previously it is important to consider where on the extinction/deciview curve the reductions would occur. Consequently, referring to Figure A.3-5, in GUMO's case a 10 (1/Mm) extinction change results in a much larger deciview improvement. Therefore in the analysis we have conducted, we do not believe it is enough to consider just the magnitude of extinction from a facility, we believe we must also consider the percent analysis. We provided the maximum extinction metrics to provide some general context between the average and maximum impacts for days that make up the 20% worst days. As discussed in Section A.3, we cannot evaluate CAMx modeling results for RP using CALPUFF metrics for BART, but examining the maximum does give some insight into the distribution of impacts. In addition, it is worth noting that a number of facilities made the top 10 for more than one Class I area.

Table A.4-1a. Top 10 Impacting sources ranked on % Extinction on Avg. 20% Worst Days at WIMO

Class I	**Wichita Mountains Wilderness**				
Top 10	Plant Name	Extinction	% Contribution	Max extinction during 20% worst days	Max % contribution during 20% worst days
1	MONTICELLO STM	1.275	1.73%	3.551	2.55%
2	BIG BROWN	1.169	1.59%	3.297	2.37%
3	MARTIN LAKE ELE	0.686	0.93%	1.900	1.36%
4	WORKS NO 4	0.635	0.86%	2.066	2.11%
5	RELIANT ENERGY	0.478	0.65%	1.310	0.94%
6	OKLAUNION POWER	0.417	0.57%	1.049	0.75%
7	SOMMERS DEELY S	0.410	0.56%	1.134	0.81%
8	HW PIRKEY POWER	0.368	0.50%	1.036	0.74%
9	COLETO CREEK PL	0.354	0.48%	0.995	0.71%
10	WELSH POWER PLA	0.349	0.47%	0.963	0.63%
Total Projected extinction in 2018 (Avg. 20% Worst Days)					73.547

Table A.4-1b. Top 10 Impacting sources ranked on % Extinction on Avg. 20% Worst Days at BIBE

Class I	**Big Bend National Park**				
Top 10	Plant Name	Extinction	% Contribution	Max extinction during 20% worst days	Max % contribution during 20% worst days
1	SOMMERS DEELY S	0.276	0.57%	1.193	1.13%
2	COLETO CREEK PL	0.216	0.44%	0.937	0.89%
3	BIG BROWN	0.212	0.44%	0.923	0.87%
4	RELIANT ENERGY	0.103	0.21%	0.441	0.42%
5	LIGNITE-FIRED P	0.101	0.21%	0.428	0.41%
6	MONTICELLO STM	0.096	0.20%	0.413	0.39%
7	W A PARISH STAT	0.090	0.18%	0.385	0.36%
8	BIG SPRING CARB	0.084	0.17%	0.356	0.34%
9	SANDOW STEAM EL	0.080	0.16%	0.342	0.32%
10	MARTIN LAKE ELE	0.080	0.16%	0.342	0.32%
Total Projected extinction in 2018 (Avg. 20% Worst Days)					48.613

Table A.4-1c. Top 10 Impacting sources ranked on % Extinction on Avg. 20% Worst Days at GUMO

Class I	Guadalupe Mountains				
Top 10	Plant Name	Extinction	% Contribution	Max extinction during 20% worst days	Max % contribution during 20% worst days
1	TOLK STATION	0.302	0.65%	1.004	1.55%
2	BIG BROWN	0.235	0.50%	0.809	1.25%
3	BIG SPRING CARB	0.226	0.48%	0.775	1.19%
4	SOMMERS DEELY S	0.208	0.44%	0.688	1.06%
5	HARRINGTON STAT	0.184	0.39%	0.606	0.93%
6	MONTICELLO STM	0.114	0.24%	0.391	0.60%
7	WAHA PLANT	0.113	0.24%	0.387	0.60%
8	RELIANT ENERGY	0.111	0.24%	0.372	0.57%
9	MARTIN LAKE ELE	0.104	0.22%	0.351	0.54%
10	COLETO CREEK PL	0.066	0.14%	0.227	0.35%
Total Projected extinction in 2018 (Avg. 20% Worst Days)					46.776

CONSIDERATION OF RECENT EMISSIONS

The CENRAP modeling was based on an IPM (Integrated Planning Model) that estimated EGU future emissions in 2018 including reductions for CAIR across the Eastern half of the United States. This analysis was conducted in 2006 and projected that Texas would actually be a purchaser of SO_2 credits, and not as much high level controls would be placed on Texas EGU sources. Given the length of time between 2006 when the IPM analysis was conducted, and 2013 when we were conducting this analysis, we had some concern that projections could be off for the EGUs in Texas. This was especially important considering that some of these same EGUs made up the majority of sources that made the top 10 list for each of the three Class I areas. Information available also indicates that SO_2 credits are much cheaper than originally projected, therefore more credits may have been used in lieu of emission reductions. We also weighed the technique that Texas has used in estimating emissions from EGUs for future years (including 2018) in ozone attainment demonstration SIPs in DFW and HGB[44]. For these photochemical modeling analyses with CAMx they have relied upon the recent CEM data that is also included in CAMD's databases in conjunction with information on recently permitted EGUs for estimating the emissions to model for EGUs in Texas in 2018 as these emission levels are near CAIR Phase II control levels.

At the time we were conducting this analysis the CSAPR was still being litigated and the future of the rule was uncertain. We were cognizant of the fact that even if CSAPR makes it completely through litigation and is upheld, the actual SO_2 allowances for Texas are not much different than the CAIR Cap for Texas, so large additional reductions over current emission levels were not expected. Also, we have projected that controls for MATS may generate the installation of additional scrubbers in Texas that could potentially result in further SO_2 reductions. Texas recently submitted comments to us on a more recent IPM projection that was going to be part of a new modeling platform for national rule making[45]. In these comments and comments from several EGU owners in Texas, the assertion was that no significant amount of additional SO_2 controls are expected due to compliance with MATS. The comments also pointed out that as some of our cursory research had also indicated that no large SO_2 control projects were planned at most of the sources we were evaluating. Therefore, based on Texas' recent comments and other information, we concluded considerable uncertainty exists as to whether any further reductions of SO_2 will occur beyond current emission levels as a result of compliance with MATS or CSAPR. Overall this information supports looking at recent actual emissions to represent future emission levels in 2018.

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[44] HGB 1997 8-Hour Ozone standard attainment demonstration approved by EPA in 2013, see TSD materials for 2010 "Appendix B Emission Modeling for the HGB Attainment Demonstrtion SIP Revision for the 1997 Eight-Hour Ozone Standard" on page B-78, "09017SIP_ado_Appendix_B.pdf".; DFW 1997 8-Hour Ozone standard attainment demonstration submitted to EPA, see TSD Appendix B: Emission Modeling for the DFW Attainment Demonstration SIP Revision for the 1997 Eight-Hour Ozone Standard, Page B-39, "AppB_EI_ado.pdf"; DFW 2008 8-Hour Ozone standard attainment demonstration proposed for adoption Dec. 10, 2014 and posted October 2014, see TSD materials "Appendix B Emissions Modeling for the Dallas-Fort Worth Attainment Demonstration State Implementation Plan Revision for the 2008 Eight-Hour Ozone Standard" Starting Page 40.,DFWAD_SIP_Appendix B.pdf

[45] Texas comments on Draft IPM modeling conducted by EPA for potential national rule making platformprovided on June 26, 2014. In this docket materials as ""TCEQ comment letter to EPA on draft modeling platform dated June 24, 2014. '2018 EMP signed.pdf'

ENVIRON finished the initial 2018 source apportionment modeling for EPA in late summer 2013. Therefore the latest full year of CEM data available was 2012. We evaluated recent emissions for the 38 sources that were available through CAMD's CEM databases. We evaluated the average and maximum annual tpy for the 2008-2012 data (most recent 5 year period available). We contrasted this data with the emission rates that we had modeled. Table A.4-2 summarizes both the CAMD data and modeled emission rate in tpy.

Table A.4-2. 2008-2012 CAMD CEM emissions contrasted with Modeled emission rates for 38 facilities modeled

ID	Plant Name	2008-2012 CAMD CEM data				Modeled SO2	Modeled NOx
		Average annual SO2	Max Annual SO2 (tons)	Average annual NOx	Max Annual NOx (tons)		
1	BIG BROWN	61114	66227	5842	6753	*47158*	*6685*
2	BIG SPRING CARBON BLACK					*17823*	*1135*
3	BORGER CARBON BLACK					*4338*	*636*
4	BORGER CARBON BLACK PLT					*6564*	*1048*
5	COLETO CREEK PLANT	17280	21453	3460	4198	*16100*	*4262*
6	FAYETTE POWER PROJECT	1117	1117	6164	7171	*1307*	*7790*
7	FULLERTON GAS PLANT					*3040*	*1861*
8	GIBBONS CREEK	830	830	1735	2277	*893*	*1885*
9	GOLDSMITH GASOLINE PLANT					*1916*	*1129*
10	GREAT LAKES CARBON LLC					*12881*	*824*
11	GUADALUPE COMPRESSOR STATION					*3*	*850*
12	HARRINGTON STATION	18418	23610	6846	9932	*22715*	*5537*
13	HOLCIM (TEXAS) LP					*4518*	*5018*
14	HW PIRKEY POWER PLT	4263	7255	3809	4274	*19483*	*4864*
15	KEYSTONE COMPRESSOR STN.					*0*	*3770*
16	KEYSTONE PLANT					*672*	*2809*
17	LIGNITE-FIRED POWER PLANT	10601	11064	3155	3292	*6603*	*4213*
18	MARTIN LAKE ELECTRICAL STATION	67423	84987	14884	16907	*36018*	*19024*
19	MIDLOTHIAN PLANT					*3263*	*6067*

Table A.4-2. 2008-2012 CAMD CEM emissions contrasted with Modeled emission rates for 38 facilities modeled (continued)

ID	Plant Name	2008-2012 CAMD CEM data				*Modeled SO2*	*Modeled NOx*
		Average annual SO2	Max Annual SO2 (tons)	Average annual NOx	Max Annual NOx (tons)		
20	MONTICELLO STM ELE STN	54104	73212	8543	11434	*51129*	*12236*
21	NEWMAN STATION	8	11	1766	2251	*0*	*50*
22	NORTH TEXAS CEMENT CO.					*190*	*712*
23	ODESSA CEMENT PLANT					*469*	*2510*
24	OKLAUNION POWER STATION	3611	4386	6428	8097	*7158*	*6303*
25	PEGASUS GAS PLANT					*107*	*2666*
26	RELIANT ENERGY LIMESTONE	21849	25015	12969	14433	*17840*	*10907*
27	SANDOW STEAM ELECTRIC	21969	25594	1396	1500	*8477*	*1387*
28	SHERHAN PLANT					*685*	*3079*
29	SOMMERS DEELY SPRUCE PWR	20073	26589	7848	9933	*26106*	*8048*
30	STREETMAN PLANT					*4886*	*973*
31	TEXARKANA MILL					*557*	*2359*
32	TNP ONE STEAM ELECTRIC ST	4916	6185	1529	2022	*1687*	*2342*
33	TOLK STATION	21258	24474	6982	7777	*22133*	*5250*
34	W A PARISH STATION	46783	55159	4857	5936	*15478*	*4390*
35	WAHA PLANT					*4060*	*594*
36	WELSH POWER PLANT	25947	28409	10486	11177	*14284*	*6171*
37	WORKS NO 4					*623*	*8929*
38	SANDOW 5 GENERATING PLANT	1733	2153	1327	1398	*1964*	*1529*

We note that the data indicates that a number of facilities have actual emissions that are much higher than modeled. For instance, Big Brown, Sandow, and Martin Lake were all significantly higher than modeled rates, with Martin Lake having over 90% more SO_2 emissions than modeled. Both Pirkey and Oklaunion had much smaller actual SO_2 emissions than modeled. Other examples of the differences between actual and modeled emissions can also be seen.

FINAL SELECTION OF SOURCES FOR ADDITIONAL VISIBILITY ANALYSIS

Given the significant range in impacts among the 38 facilities on Class I areas, we wanted to narrow the source list for further visibility evaluation to a smaller subset of sources that would potentially yield the most visibility improvement. We were primarily interested in generating a smaller group of sources that could potentially yield visibility improvements at WIMO, BIBE, and GUMO.

In order to choose a subset of sources for further evaluation we considered several different things. Some individual source/facility analyses for RP have used CALPUFF modeling results. We have CAMx results that allow us to evaluate individual source impacts directly to the same metrics used for RP analysis (W20% and B20%). We examined our modeling results for any natural break points that indicated a significant drop-off in impacts that would allow us to select a natural subset of the largest impacting sources. This examination yielded break points around 1%, 0.5% and 0.3%. We note that Texas used 0.5 Mm^{-1} and Oklahoma used 1 Mm^{-1} of extinction from all sources in a state as a threshold for inviting a state to consult.[46] Depending on Class I area, these values would equate to a value of approximately 0.6% to 4%. Given that consultation was based on all emissions from an upwind state, not just point source emissions, the actual reductions from individual point sources in a state would only be a small percentage of this amount that would have been potentially discussed in consultation. For example if 1/3 of the impacts of a state came from one source, which is a conservative approach, that source might be considered for potential controls in consultation for impacts that could be approximately 0.2% to 1.33% of the extinction at a Class I area. Without specific modeling, many states initially focused on the largest emissions sources in the state until they got to a point of diminishing visibility improvements. There are a number of different approaches used by states in development of sources for RP evaluation but it usually centered around the general premise of evaluating the biggest sources and the biggest impactors on visibility. For our analysis we tried utilizing an extinction percentage of 1% for a facility's impacts with a consideration that some facilities have two or three units and this metric would equate to 0.5% or 0.33% extinction per unit. As discussed below, we concluded that this was a reasonable way to arrive at some common breakpoints/drop-offs in potential visibility improvements. This reduced the sources we had to examine to about a dozen facilities and helped set a context for what level of impacts may warrant further modeling to assist in a full four factor analysis for our RP/LTS analysis.

We continued to evaluate these sources, considering the different approaches highlighted in the information above: maximum actual emissions, extinction, and extinction percentage. In our final analyses we evaluated these sources based on facility impacts and also on a unit basis impact. We used a linear scalar approach to scale the impacts based on the modeled emission rate and associated impact level to result in an estimated impact based on actual emissions.

[46] See Texas Regional Haze SIP Appendix 4-1: Summary of Consultation Calls and Section X.A. of the Oklahoma Regional Haze SIP

Since as we have noted earlier, the extinction from most sources was almost all due to SO_2 emissions, we scaled the impacts based on SO_2 emissions.

Initially we evaluated the average extinction on the 20% worst days for each of the 38 facilities based on the modeled emissions and also adjusted based on the average of the 2008-2012 annual tpy SO_2 emissions. Table A.4-3 includes an evaluation of the extinction levels as a percentage of total extinction at the Class I area for each of the 38 facilities in our initial modeling. This table includes this metric for each of the 3 Class I areas for both the modeled emissions and the estimated facility impact based upon the average of 2008-2012 CEM data. As discussed elsewhere, the model was responding linearly to emission changes, so we scaled the modeling based on CEM data to get CEM based impact estimates. The sources are ranked based on the highest to lowest modeled extinction at the highest percentage extinction at one of the three Class I areas. As detailed in the top of the table we have include a ">1%" next to the name of each facility that had above a 1% extinction impact on a Class I area based on either modeled or CEM data. From other information in the spreadsheet that this table was developed, we also factored in if the facility or a unit(s) at the facility had impacts above 0.5% with a "(+)" and a "(++)" when impacts were above 0.3%.[47] We further shaded the extinction percentages in the table when a facility had units greater than 0.3%. As another point of context, the top 3-4 facilities have more impact than all emissions sources in Louisiana on WIMO's extinction levels.

When we examined the impacts, we noted that some source impacts are quite low and some impacts were spread among several sources at the facility, making individual unit impacts even smaller. We therefore concluded that some of these impacts did not warrant further evaluation for this planning period and dropped them from Table A.4-3. With this shortened list of facilities, we then scaled the ENVIRON modeling and the estimated impacts of each facility to estimate unit specific values for the percentage of extinction due to each unit at a facility. We did this because our four factor RP analysis evaluating potential controls would be completed on a unit specific basis. In Table A.4-4 we present the results of these estimates. We have shaded all individual sources/units at a facility that had impacts over a 0.3% threshold using the model based analysis or the estimate based on 2008-2012 average CEM data.

We concluded that any unit with an estimated impact greater than 0.3% would be further evaluated. We believe that using a percent impacts approach is appropriate because of its linkage to the reasonable progress concept. For example, a source that has a smaller absolute impact on a relatively cleaner area but a higher percentage impact might be considered for control so that the cleaner area can potentially make progress. Since we had recent actual emissions, and any feasibility of controls would likely be based on reductions from actuals, we weighed the estimated impacts based on actuals in addition to the modeled impact levels.

We used the 0.3% threshold only as a way to identify a reasonable set of sources to evaluate further. At this point, the resulting reasonably broad cutpoint served as a starting place from which to further analyze individual source impacts in the second round of modeling, and balance them against any cost effective controls that could be identified. We describe that process below.

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[47] Electronic file in the Docket named "Source selection analysis TX RH 1-31-14.xlsx" and "Source selection analysis TX RH-es-1-31-14.xlsx.

Table A.4-3. Percent of extinction for the Avg. Impacts on W20% days.(Facilities)

Ranked by Facility Highest Avg impacts on W20% days for Class I areas in OK & TX

1. Facilities with either modeled or estimated impacts based on recent EI that are above 1% have '(> 1%)'
2. Facilities that have unit(s) with modeled or estimated impacts based on recent EI above 0.5% have '(+)', and above 0.3% have '(++)'
3. Facilities with unit(s) greater than 0.3% impact are shaded

Plantname		Modeled Facility Impacts at each of the Class I areas in OK & TX Most Impacted Area	2nd Most Impacted Area	3rd Most Impacted Area	Most Impacted Area	2nd Most Impacted Area	3rd Most Impacted Area	Estimated Facility Impact Adjusted to reflect 2008-2012 Avg. Emissions Most Impacted Area	2nd Most Impacted Area	3rd Most Impacted Area
MONTICELLO STM ELE STN	(>1%) (+)	1.734%	0.244%	0.197%	WIMO	GUMO	BIBE	1.834%	0.258%	0.209%
BIG BROWN	(>1%) (+)	1.590%	0.502%	0.435%	WIMO	GUMO	BIBE	2.060%	0.651%	0.564%
MARTIN LAKE ELECTRICAL STATION	(>1%) (+)	0.932%	0.223%	0.164%	WIMO	GUMO	BIBE	1.745%	0.417%	0.306%
WORKS NO 4	(++)	0.863%	0.015%	0.011%	WIMO	GUMO	BIBE			
RELIANT ENERGY LIMESTONE	(++)	0.650%	0.238%	0.212%	WIMO	GUMO	BIBE	0.797%	0.291%	0.260%
TOLK STATION	(++)	0.646%	0.186%	0.096%	GUMO	WIMO	BIBE	0.620%	0.179%	0.093%
SOMMERS DEELY SPRUCE PWR		0.569%	0.558%	0.444%	BIBE	WIMO	GUMO	0.454%	0.446%	0.355%
OKLAUNION POWER STATION		0.567%	0.076%	0.075%	WIMO	BIBE	GUMO	0.286%	0.039%	0.038%
HW PIRKEY POWER PLT		0.501%	0.130%	0.090%	WIMO	GUMO	BIBE	0.097%	0.025%	0.017%
BIG SPRING CARBON BLACK		0.482%	0.304%	0.173%	GUMO	WIMO	BIBE			
COLETO CREEK PLANT	(+)	0.481%	0.444%	0.141%	WIMO	BIBE	GUMO	0.513%	0.473%	0.150%
WELSH POWER PLANT	(++)	0.475%	0.071%	0.054%	WIMO	GUMO	BIBE	0.862%	0.129%	0.099%
HARRINGTON STATION		0.393%	0.162%	0.070%	GUMO	WIMO	BIBE	0.317%	0.131%	0.057%
SANDOW STEAM ELECTRIC	(+)	0.376%	0.164%	0.119%	WIMO	BIBE	GUMO	0.974%	0.426%	0.308%
W A PARISH STATION	(++)	0.291%	0.185%	0.089%	WIMO	BIBE	GUMO	0.881%	0.559%	0.268%
WAHA PLANT		0.242%	0.070%	0.036%	GUMO	BIBE	WIMO			
GREAT LAKES CARBON LLC		0.238%	0.093%	0.038%	WIMO	BIBE	GUMO			
HOLCIM (TEXAS) LP		0.217%	0.055%	0.042%	WIMO	GUMO	BIBE			
SAN MIGUEL	(++)	0.207%	0.164%	0.107%	BIBE	WIMO	GUMO	0.333%	0.263%	0.172%
STREETMAN PLANT		0.196%	0.047%	0.047%	WIMO	GUMO	BIBE			
MIDLOTHIAN PLANT		0.167%	0.044%	0.028%	WIMO	GUMO	BIBE			
FULLERTON GAS PLANT		0.106%	0.037%	0.029%	GUMO	BIBE	WIMO			
BORGER CARBON BLACK PLT		0.106%	0.057%	0.023%	GUMO	WIMO	BIBE			
SANDOW 5 GENERATING PLANT		0.100%	0.043%	0.027%	WIMO	BIBE	GUMO	0.071%	0.031%	0.019%
TNP ONE STEAM ELECTRIC ST		0.082%	0.030%	0.023%	WIMO	BIBE	GUMO			
FAYETTE POWER PROJECT		0.072%	0.031%	0.031%	WIMO	GUMO	BIBE	0.072%	0.031%	0.000%
GOLDSMITH GASOLINE PLANT		0.072%	0.022%	0.020%	GUMO	BIBE	WIMO			
BORGER CARBON BLACK		0.066%	0.038%	0.016%	GUMO	WIMO	BIBE			
ODESSA CEMENT PLANT		0.066%	0.021%	0.012%	GUMO	BIBE	WIMO			
KEYSTONE PLANT		0.055%	0.012%	0.010%	GUMO	BIBE	WIMO			
TEXARKANA MILL		0.036%	0.009%	0.005%	WIMO	BIBE	GUMO			
NORTH TEXAS CEMENT CO.		0.035%	0.007%	0.006%	WIMO	BIBE	GUMO			
KEYSTONE COMPRESSOR STN.		0.035%	0.006%	0.001%	GUMO	BIBE	WIMO			
GUADALUPE COMPRESSOR STATION		0.032%	0.000%	0.000%	GUMO	BIBE	WIMO			
SHERHAN PLANT		0.032%	0.012%	0.008%	GUMO	WIMO	BIBE			
GIBBONS CREEK		0.031%	0.014%	0.010%	WIMO	BIBE	GUMO			
PEGASUS GAS PLANT		0.015%	0.008%	0.003%	BIBE	GUMO	WIMO			
NEWMAN STATION		0.005%	0.000%	0.000%	GUMO	BIBE	BIBE			
Class I area Codes:		OK & TX	WIMO = Wichita Mtns.; GUMO = Guadalupe Mtns.; BIBE = Big Bend							

Table A.4-4. Percent of extinction for the Avg. Impacts on W20% days.(Units)

Ranked by Estimated Unit Avg. Extinction % Impacts on W20% for Class I areas in OK & TX

1. Individual Units with impacts greater than 0.3% are shaded

Plantname	Unit	Modeled Facility Impacts at each of the Class I areas in OK & TX % at Most Impacted Area	Most Impacted Area	% at 2nd Most Impacted Area	2nd Most Impacted Area	% at 3rd Most Impacted Area	3rd Most Impacted Area	Estimated Unit Impact Adjusted to reflect 2008-2012 Avg. Emissions Unit Max at most impacted Area	Unit Max at second most impacted Area	Unit Max at third most impacted Area
BIG BROWN	1	0.786%	WIMO	0.249%	GUMO	0.215%	BIBE	1.030%	0.326%	0.282%
BIG BROWN	2	0.803%	WIMO	0.254%	GUMO	0.220%	BIBE	1.030%	0.326%	0.282%
SANDOW STEAM ELECTRIC	1	0.376%	WIMO	0.164%	BIBE	0.119%	GUMO	0.974%	0.426%	0.308%
MONTICELLO STM ELE STN	1	0.654%	WIMO	0.092%	GUMO	0.074%	BIBE	0.691%	0.097%	0.079%
MONTICELLO STM ELE STN	2	0.673%	WIMO	0.095%	GUMO	0.077%	BIBE	0.666%	0.094%	0.076%
MARTIN LAKE ELECTRICAL STATION	1	0.296%	WIMO	0.071%	GUMO	0.052%	BIBE	0.609%	0.145%	0.107%
MARTIN LAKE ELECTRICAL STATION	2	0.313%	WIMO	0.075%	GUMO	0.055%	BIBE	0.572%	0.137%	0.100%
MARTIN LAKE ELECTRICAL STATION	3	0.323%	WIMO	0.077%	GUMO	0.057%	BIBE	0.564%	0.135%	0.099%
COLETO CREEK PLANT	1	0.481%	WIMO	0.444%	BIBE	0.141%	GUMO	0.513%	0.473%	0.150%
MONTICELLO STM ELE STN	3	0.406%	WIMO	0.057%	GUMO	0.046%	BIBE	0.477%	0.067%	0.054%
WORKS NO 4	1	0.448%	WIMO	0.008%	GUMO	0.002%	BIBE			
WORKS NO 4	2	0.415%	WIMO	0.007%	GUMO	0.010%	BIBE			
RELIANT ENERGY LIMESTONE	2	0.183%	WIMO	0.067%	GUMO	0.060%	BIBE	0.414%	0.151%	0.135%
RELIANT ENERGY LIMESTONE	1	0.467%	WIMO	0.171%	GUMO	0.152%	BIBE	0.383%	0.140%	0.125%
San Miguel	1	0.207%	BIBE	0.164%	WIMO	0.107%	GUMO	0.333%	0.263%	0.172%
TOLK STATION	1	0.338%	GUMO	0.097%	WIMO	0.050%	BIBE	0.312%	0.090%	0.047%
TOLK STATION	2	0.308%	GUMO	0.089%	WIMO	0.046%	BIBE	0.308%	0.089%	0.046%
WELSH POWER PLANT	3	0.393%	WIMO	0.059%	GUMO	0.045%	BIBE	0.301%	0.045%	0.034%
W A PARISH STATION	7	0.072%	WIMO	0.046%	BIBE	0.022%	GUMO	0.298%	0.189%	0.091%
W A PARISH STATION	6	0.071%	WIMO	0.045%	BIBE	0.022%	GUMO	0.289%	0.184%	0.088%
WELSH POWER PLANT	2	0.041%	WIMO	0.006%	GUMO	0.005%	BIBE	0.287%	0.043%	0.033%
OKLAUNION POWER STATION	1	0.567%	WIMO	0.076%	BIBE	0.075%	GUMO	0.286%	0.039%	0.038%
WELSH POWER PLANT	1	0.041%	WIMO	0.006%	GUMO	0.005%	BIBE	0.274%	0.041%	0.031%
W A PARISH STATION	8	0.063%	WIMO	0.040%	BIBE	0.019%	GUMO	0.240%	0.152%	0.073%
SOMMERS DEELY SPRUCE PWR	2	0.232%	BIBE	0.228%	WIMO	0.181%	GUMO	0.201%	0.197%	0.157%
SOMMERS DEELY SPRUCE PWR	1	0.236%	BIBE	0.232%	WIMO	0.184%	GUMO	0.188%	0.184%	0.147%
HARRINGTON STATION	3	0.134%	GUMO	0.055%	WIMO	0.024%	BIBE	0.111%	0.046%	0.020%
HARRINGTON STATION	1	0.123%	GUMO	0.051%	WIMO	0.022%	BIBE	0.103%	0.043%	0.019%
HARRINGTON STATION	2	0.137%	GUMO	0.056%	WIMO	0.024%	BIBE	0.102%	0.042%	0.018%
HW PIRKEY POWER PLT	1	0.501%	WIMO	0.130%	GUMO	0.090%	BIBE	0.097%	0.025%	0.017%
SOMMERS DEELY SPRUCE PWR	3	0.095%	BIBE	0.093%	WIMO	0.074%	GUMO	0.061%	0.060%	0.048%
W A PARISH STATION	9	0.086%	WIMO	0.054%	BIBE	0.026%	GUMO	0.053%	0.034%	0.016%
SANDOW 5 GENERATING PLANT		0.048%	WIMO	0.021%	BIBE	0.013%	GUMO	0.036%	0.015%	0.010%
SANDOW 5 GENERATING PLANT		0.051%	WIMO	0.022%	BIBE	0.014%	GUMO	0.035%	0.015%	0.010%
FAYETTE POWER PROJECT	2	0.025%	WIMO	0.011%	GUMO		BIBE	0.025%	0.011%	0.000%
FAYETTE POWER PROJECT	1	0.024%	WIMO	0.010%	GUMO		BIBE	0.024%	0.010%	0.000%
FAYETTE POWER PROJECT	3	0.023%	WIMO	0.010%	GUMO		BIBE	0.023%	0.010%	0.000%
SOMMERS DEELY SPRUCE PWR	4	0.005%	BIBE	0.005%	WIMO	0.004%	GUMO	0.004%	0.004%	0.003%
TNP ONE STEAM ELECTRIC ST	1		WIMO		BIBE		GUMO	0.000%	0.000%	0.000%
TNP ONE STEAM ELECTRIC ST	2		WIMO		BIBE		GUMO	0.000%	0.000%	0.000%

After coming up with a list of sources/units based on Table A.4-4 we continued to evaluate whether to include or exclude sources that were close to the cutpoint, or for which we had additional information that would indicate they should be excluded in the second round of visibility modeling. In so doing, we noted the following:

- Martin Lake had two units above the cutpoint for both modeled emissions and recent actuals, we included Unit #1 because it was above based on actuals and very close to the cutpoint with modeled values.
- Works #4 (glass plant) had modeled NOx values much higher than recent actuals. As we describe elsewhere in our TSD, one of the two furnaces (the main NOx sources) had been rebuilt and NOx controls had been installed. The plant is located in Wichita Falls, TX and is relatively close to WIMO, so it was one of the few sources that did have a sizeable amount of impact due to modeled NOx emissions. We note though that the modeled NOx was over five times higher than recent actuals and permit limits. There is some amount of SO_2 impacts, but taking into account the large decrease in NOx emissions compared to modeled emissions and that the glass furnaces are only rebuilt approximately every 10 years, we determined it was acceptable to drop this source from consideration this time. We suggest that the TCEQ evaluate this source in the future as part of a future SIP RP analysis.
- San Miguel was below the 0.3% threshold based on the modeled inventory and slightly above the threshold based on recent actuals. As noted elsewhere and included in the docket, San Miguel has completed SO2 scrubber upgrades and brought their scrubber systems to near current day standards, so we did not think further control should be considered as part of this RP review and are making existing controls enforceable as part of this proposed action.
- Welsh had 1 unit above the 0.3% threshold but the other two units were below the threshold. The CENRAP RPO IPM projections appears to assume that two of the three units would add scrubbers. This was not in the EPA IPM run so we concluded it must have been a correction made in the RPO IPM run. Recent emissions are approximately equal across all three units. As we discuss elsewhere in our TSD, Unit 2 is under a consent decree to shut down, so it was not considered further. Nevertheless, we included all three units in the additional visibility modeling to be conservative and be able to provide a visibility analysis if needed.
- Several units at W. A. Parish were very close to 0.3% based on actual emissions. We therefore included the Parish units in order to provide visibility information if needed.
- Oklaunion had model based impacts above 0.3% but just below 0.3% with the actual emissions analysis. Oklaunion is close to WIMO and its impacts are a combination of NOx and SO_2 impacts. However, we concluded that if just the impacts from SO_2 were examined, the facility's impacts would be below the 0.3% value. Therefore Oklaunion was not included in additional visibility modeling.
- The Sommers Deely Spruce complex is below the 0.3% value for each Class I area, but it does impact all three Class I areas at about 0.2-0.23% which raised a question concerning its cumulative impacts. However, Sommers Deely Spruce has indicated that they are shutting down two of their dirtiest sources by 2018. Therefore we did not include the Sommers Deely Spruce units in our additional visibility modeling.

- Pirkey had high modeled emissions and was above 0.3%, but the value was less than 0.1% for the value based on actuals, so we did not include in our additional visibility modeling.
- Big Spring carbon's facility impacts were above 0.3% with modeled emissions but there are 9 units with sizeable emissions. However it was unclear whether they could be controlled through one scrubber or would be treated as 9 units with individual impacts much smaller. Therefore we did not include them in our additional visibility modeling.

A.5 Preparation of Emissions Scenarios for Potential Controls - Additional visibility Modeling

The above described exercise narrowed the potential sources for further visibility modeling down to 9 facilities with 21 units total. We then developed emission scenarios to model that would result in multiple visibility data points, spanning any likely control scenarios for each unit. This information would be used to estimate the amount of visibility benefit that could be expected from installation of controls on each of the 21 units. Based on the general premise that any potential controls would be for SO_2, we formulated model runs that would span the range of potential controls/emissions we planned to examine. Our goal was to maximize the amount of data points so we could estimate the visibility benefit at Class I areas from any decrease in emissions that would result from any SO_2 control we would examine. ENVIRON assisted EPA in conducting two additional runs, with one run being based on using a low SO_2 control such as DSI and one run based on a high SO_2 control that would reflect SDA or wet FGD scrubbing.

We noted that some of the units we were evaluating were already equipped with older underperforming scrubbers, most of which were partially bypassed. For the units with scrubber bypasses, we lacked information on scrubber absorber efficiencies represented by the recent actual emission levels and the amount of bypass that has occurred. This made it impossible to estimate the current base control efficiency and the amount of additional reductions that would occur if the unit was further controlled based soley on the actual emissions data.. Therefore, as is described in our Cost TSD, we used Coal Data from EIA Form 923. This information enabled us to assess the total sulfur levels coming into a unit, to determine an uncontrolled baseline, and then estimate the tpy emissions for the low and high control scenarios, to cover the potential range of upgraded scrubber control efficiencies.

Table A.5-1 displays a summary of the EIA data. The baseline SO_2 emissions were calculated by evaluating the 2008-2012 data, removing the minimum and maximum values, and then averaging the three remaining annual values to result in an annual average tpy uncontrolled baseline. We used a general estimate for what low controls and high controls might achieve. In the case when we had basically identical units at a facility we sometimes chose two different efficiencies to give more data points for creating a unit/facility specific mathmatical relationship. For example, Big Brown has two units that are nearly identical and do not have a large variation between their 3 year annual uncontrolled baseline average. In this case we chose to model Unit 1 at 40% for DSI controls and Unit 2 at 60% for DSI controls, in effect giving us more data points to create the "x" emissions yields "y" deciview benefit relationship. We also considered the emission level modeled in the 2018 basecase projection described above and selected a low-level controlled emission level such that we would not duplicate a modeled emission level. For example, the Sandow 4 unit was modeled at an emission level that represents approximately 90%

control in the 2018 basecase, therefore we selected a low-level control of 75% rather than the 90% we selected for upgraded scrubber units at other facilities to generate another useful data point for creating a linear relationship. In the high control cases we also estimated the scrubbers as 95% control but also evaluated a floor emission rate of 0.06 lb of SO_2/MMBtu and used the higher of the two rates for the modeling analysis (highlighted in red in the table below).

Table A.5-2 summarizes the efficiencies used in both the high and low control scenarios for each unit. Table A.5-3 summarizes the actual emissions provided to ENVIRON for each of the control scenario runs.

Table A.5-1. EIA data and calculating potential emissions levels correlated to certain controls and efficiencies

Unit #	Facility	CEM CAMD		3 yr avg. coal data uncontrolled annual emissions(eliminate max and min)	scrubbed?	bypass	CENRAP 2018	Low			High		
		2008-2012 Avg.	3-yr avg annual emissions (eliminate max and min)					low modeled control efficiency	low controlled emissions	emission rate (5 yr avg heat input)	high modeled control efficiency	High control emissions	high control emission rate
1	Big Brown	30561	30591	33513			23328	40%	20108	0.90	95%	1676	0.075
2	Big Brown	30554	30674	33357			23831	60%	13343	0.59	95%	1668	0.074
1	Coleto Creek	17280	17084	19678			16225	50%	9839	0.40	92%	1492	0.060
1	Limestone	10500	10599	49484	Y	Y	12817	85%	7423	0.23	95%	2474	0.075
2	Limestone	11349	11014	52299	Y	Y	5023	90%	5230	0.16	95%	2615	0.080
1	Martin Lake	23517	24872	77111	Y	Y	11442	75%	19278	0.60	95%	3856	0.119
2	Martin Lake	22105	23208	77680	Y	Y	12080	85%	11652	0.35	95%	3884	0.117
3	Martin Lake	21801	21597	74442	Y	Y	12495	90%	7444	0.25	95%	3722	0.126
1	Monticello	20388	20522	22810			19298	40%	13686	0.61	94%	1355	0.060
2	Monticello	19643	19746	23002			19853	60%	9201	0.41	94%	1346	0.060
3	Monticello	14073	15019	35308	Y	Y	11978	90%	3531	0.11	95%	1851	0.060
1	Sandow 4	21969	22629	91912	Y	Y	8477	75%	22978	0.96	95%	4596	0.191
1	Tolk	10702	10829	12417			11584	40%	7450	0.37	90%	1209	0.060
2	Tolk	10556	10600	11300			10549	60%	4520	0.25	90%	1103	0.060
5	WA Parish	15375	15123	18240			3763	40%	10944	0.47	92%	1397	0.060
6	WA Parish	15835	16071	18557			3840	60%	7423	0.31	92%	1419	0.060
7	WA Parish	12750	12947	16215			3324	50%	8108	0.39	92%	1244	0.060
8	WA Parish	2821	2822	17904	Y	Y	4548	90%	1790	0.08	92%	1371	0.060
1	Welsh	8244	8222	9821			1236	40%	5893	0.32	89%	1110	0.060
2	Welsh	8653	8741	9934			1233	60%	3974	0.21	89%	1117	0.060
3	Welsh	9051	9076	10028			11815	50%	5014	0.27	89%	1124	0.060

Table A.5-2. Efficiency summary for Low and High Control Runs for each Unit

Units	Model Run			
	Low			High
Big Brown 1 & 2	40%	60%		95%
Coleto Creek	50%			92%
Limestone 1 & 2	85%	90%		95%
Martin Lake 1,2,&3	75%	85%	90%	95%
Monticello 1 & 2	40%	60%		94%
Monticello 3	90%			95%
Sandow 4	75%			95%
Tolk 1 & 2	40%	60%		90%
WA Parish 5 & 6	40%	60%		92%
WA Parish 7	50%			92%
WA Parish 8	90%			92%
Welsh 1 & 2	40%	60%		89%
Welsh 3	50%			89%

Table A.5-3. Emissions provided to ENVIRON for Low control and High Control visibility modeling runs.

adjusted SO2 emissions (tpy)

Unit #	Facility	EPA/ CENRAP 2018 Phase 1 modeled emissions	low controlled emissions	High control emissions
1	Big Brown	23328	20107.64	1675.64
2	Big Brown	23831	13342.79	1667.85
1	Coleto Creek	16225	9838.94	1492.34
lim 1	Limestone	12817	7422.61	2474.20
lim 2	Limestone	5023	5229.94	2614.97
1	Martin Lake	11442	19277.73	3855.55
2	Martin Lake	12080	11652.05	3884.02
3	Martin Lake	12495	7444.15	3722.08
1	Monticello	19298	13685.89	1355.30
2	Monticello	19853	9200.89	1345.64
3	Monticello	11978	3530.81	1851.27
4	Sandow 4	8477	22978.12	4595.62
171b	Tolk	11584	7450.19	1209.35
172b	Tolk	10549	4520.10	1103.07
5	WA Parish	3763	10943.82	1396.72
6	WA Parish	3840	7422.94	1419.24
7	WA Parish	3324	8107.70	1244.01
8	WA Parish	4548	1790.38	1371.38
1	Welsh	1236	5892.87	1110.16
2	Welsh	1233	3973.62	1117.20
3	Welsh	11815	5014.24	1123.85

A.6 Results for High/Low Control Runs and Final Control Analysis Benefits

ENVIRON provided an additional report to us to document the modeling set-up, emissions processed and modeling results. These are available in the Docket and the report will be referred to as ENVIRON 2018 Control Cases.[48]

After we received the modeling we updated the baseline uncontrolled emissions for each unit based on CEM data for 2009-2013. Again, we discarded the maximum and minimum emissions years and averaged the three remaining years. We utilized this baseline to estimate the amount of tons reduced and the amount of visibility improvement.

Using the results of the unit level High and Low modeled visibility impacts and the 2018 facility level modeling described above in Section A.2, we examined the relationship between the level of emissions from a modeled site and the modeled visibility impact at each Class I area. For each facility and Class I area, the modeled data was linear with high correlation. Therefore we used the linear fit to extrapolate the anticipated visibility impact/benefit from a given level of emission/control.[49]

The modeling results for the amount of reduction in extinction from the different control levels are included in Table A.6-1a, b, and c for WIMO, BIBE and GUMO respectively. We also included Table A.6-1d which gives the same information for cumulative benefit at all the other Class I areas that were evaluated in the modeling. These tables include the extinction change based on the recent actual emissions (2009-2013) in the mid-section of the table and on the right side of the table are the change in extinction due to differing controls based the original CENRAP 2018 projections for these units.

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[48] The Report is in the docket as "Memo_TXHAZE_2018low_highControls_CAMx_12Ausg14.docx" and included spreadsheet files with the modeling results "EPA_txbart3612k_Vis_2002_2018low_PSAT_Projectedv1.xlsx", "EPA_txbart3612k_Vis_2002_2018low.GlidePath.v1.xlsx", "EPA_txbart3612k_Vis_2002_2018high_PSAT_Projectedv2.xlsx", and "EPA_txbart3612k_Vis_2002_2018high.GlidePath.v1.xlsx"

[49] See Vis modeling summary.xlsx in the docket for this action for our calculations and estimates of visibility benefits from the examined levels of controls.

Table A.6-1a. Average Change in Extinction levels at WIMO on W20% days for different controls

Visibility modeling results:			estimated change in extinction from actual emissions						change in extinction from 2018 projection (environ) with CAIR				
Unit #	Facility		DSI_low	DSI_high	SDA	WFGD	WFGD_upgrade		DSI_low	DSI_high	SDA	WFGD	WFGD_upgrade
1	Big Brown	Big Brown 1	0.378	0.680	0.718	0.741	#N/A		0.197	0.499	0.537	0.560	#N/A
2	Big Brown	Big Brown 2	0.380	0.683	0.721	0.743	#N/A		0.208	0.511	0.549	0.571	#N/A
1	Coleto Creek	Coleto Creek 1	0.176	0.317	0.329	0.336	#N/A		0.179	0.320	0.332	0.340	#N/A
lim 1	Limestone	Limestone lim 1	#N/A	#N/A	#N/A	#N/A	0.226		#N/A	#N/A	#N/A	#N/A	0.277
lim 2	Limestone	Limestone lim 2	#N/A	#N/A	#N/A	#N/A	0.249		#N/A	#N/A	#N/A	#N/A	0.064
1	Martin Lake	Martin Lake 1	#N/A	#N/A	#N/A	#N/A	0.393		#N/A	#N/A	#N/A	#N/A	0.146
2	Martin Lake	Martin Lake 2	#N/A	#N/A	#N/A	#N/A	0.339		#N/A	#N/A	#N/A	#N/A	0.159
3	Martin Lake	Martin Lake 3	#N/A	#N/A	#N/A	#N/A	0.310		#N/A	#N/A	#N/A	#N/A	0.169
1	Monticello	Monticello 1	0.220	0.397	0.419	0.428	#N/A		0.256	0.432	0.454	0.463	#N/A
2	Monticello	Monticello 2	0.203	0.365	0.385	0.393	#N/A		0.287	0.449	0.470	0.477	#N/A
3	Monticello	Monticello 3	#N/A	#N/A	#N/A	#N/A	0.303		#N/A	#N/A	#N/A	#N/A	0.257
4	Sandow	Sandow 4	#N/A	#N/A	#N/A	#N/A	0.526		#N/A	#N/A	#N/A	#N/A	0.115
171b	Tolk	Tolk 171b	0.030	0.053	0.054	0.056	#N/A		0.039	0.063	0.064	0.065	#N/A
172b	Tolk	Tolk 172b	0.033	0.059	0.059	0.061	#N/A		0.030	0.056	0.056	0.058	#N/A
5	WA Parish	WA Parish 5	0.103	0.185	0.190	0.195	#N/A		-0.048	0.034	0.039	0.044	#N/A
6	WA Parish	WA Parish 6	0.111	0.200	0.207	0.212	#N/A		-0.055	0.034	0.040	0.046	#N/A
7	WA Parish	WA Parish 7	0.090	0.161	0.166	0.170	#N/A		-0.041	0.030	0.035	0.040	#N/A
8	WA Parish	WA Parish 8	#N/A	#N/A	#N/A	#N/A	0.025		#N/A	#N/A	#N/A	#N/A	0.054
1	Welsh	Welsh 1	0.099	0.158	0.175	0.182	#N/A		-0.068	-0.009	0.008	0.015	#N/A
2	Welsh	Welsh 2	0.101	0.161	0.178	0.186	#N/A		-0.071	-0.010	0.006	0.014	#N/A
3	Welsh	Welsh 3	0.105	0.168	0.186	0.194	#N/A		0.183	0.246	0.264	0.272	#N/A

Table A.6-1b. Average Change in Extinction levels at BIBE on W20% days for different controls

Visibility modeling results:			estimated change in extinction from actual emissions						change in extinction from 2018 projection (environ) with CAIR				
Unit #	Facility		DSI_low	DSI_high	SDA	WFGD	WFGD_upgrade		DSI_low	DSI_high	SDA	WFGD	WFGD_upgrade
1	Big Brown	Big Brown 1	0.068	0.123	0.130	0.134	#N/A		0.036	0.090	0.097	0.101	#N/A
2	Big Brown	Big Brown 2	0.069	0.123	0.130	0.134	#N/A		0.037	0.092	0.099	0.103	#N/A
1	Coleto Creek	Coleto Creek 1	0.107	0.192	0.199	0.204	#N/A		0.109	0.194	0.202	0.206	#N/A
lim 1	Limestone	Limestone lim 1	#N/A	#N/A	#N/A	#N/A	0.049		#N/A	#N/A	#N/A	#N/A	0.060
lim 2	Limestone	Limestone lim 2	#N/A	#N/A	#N/A	#N/A	0.054		#N/A	#N/A	#N/A	#N/A	0.014
1	Martin Lake	Martin Lake 1	#N/A	#N/A	#N/A	#N/A	0.044		#N/A	#N/A	#N/A	#N/A	0.017
2	Martin Lake	Martin Lake 2	#N/A	#N/A	#N/A	#N/A	0.038		#N/A	#N/A	#N/A	#N/A	0.018
3	Martin Lake	Martin Lake 3	#N/A	#N/A	#N/A	#N/A	0.035		#N/A	#N/A	#N/A	#N/A	0.019
1	Monticello	Monticello 1	0.017	0.030	0.032	0.032	#N/A		0.019	0.033	0.034	0.035	#N/A
2	Monticello	Monticello 2	0.015	0.028	0.029	0.030	#N/A		0.022	0.034	0.036	0.036	#N/A
3	Monticello	Monticello 3	#N/A	#N/A	#N/A	#N/A	0.023		#N/A	#N/A	#N/A	#N/A	0.019
4	Sandow	Sandow 4	#N/A	#N/A	#N/A	#N/A	0.153		#N/A	#N/A	#N/A	#N/A	0.033
171b	Tolk	Tolk 171b	0.010	0.018	0.019	0.019	#N/A		0.013	0.022	0.022	0.023	#N/A
172b	Tolk	Tolk 172b	0.011	0.020	0.020	0.021	#N/A		0.010	0.019	0.019	0.020	#N/A
5	WA Parish	WA Parish 5	0.042	0.076	0.078	0.081	#N/A		-0.020	0.014	0.016	0.018	#N/A
6	WA Parish	WA Parish 6	0.046	0.083	0.085	0.087	#N/A		-0.023	0.014	0.017	0.019	#N/A
7	WA Parish	WA Parish 7	0.037	0.067	0.068	0.070	#N/A		-0.017	0.013	0.015	0.016	#N/A
8	WA Parish	WA Parish 8	#N/A	#N/A	#N/A	#N/A	0.010		#N/A	#N/A	#N/A	#N/A	0.022
1	Welsh	Welsh 1	0.007	0.011	0.013	0.013	#N/A		-0.005	-0.001	0.001	0.001	#N/A
2	Welsh	Welsh 2	0.007	0.012	0.013	0.013	#N/A		-0.005	-0.001	0.000	0.001	#N/A
3	Welsh	Welsh 3	0.008	0.012	0.013	0.014	#N/A		0.013	0.018	0.019	0.019	#N/A

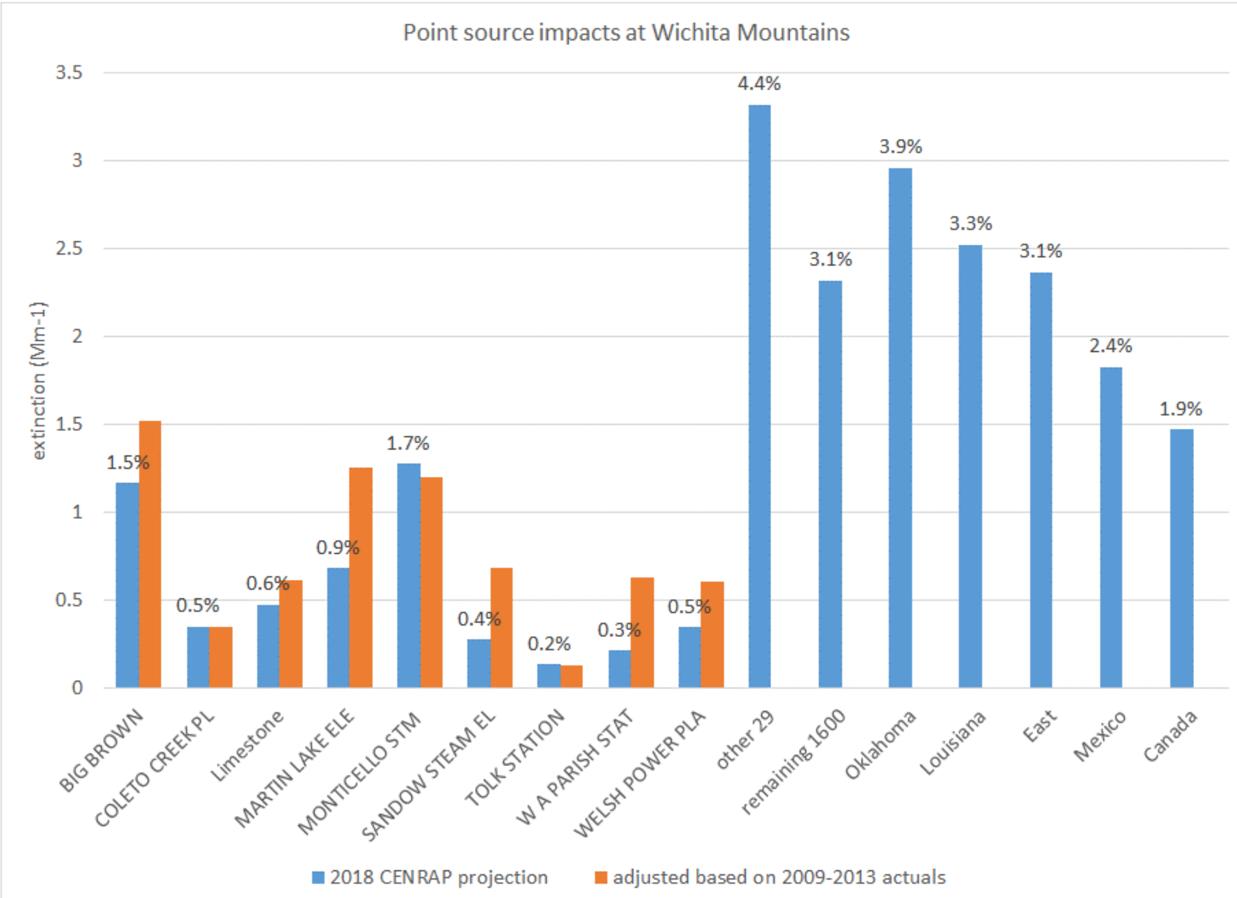
Table A.6-1c. Average Change in Extinction levels at GUMO on W20% days for different controls

Visibility modeling results:			estimated change in extinction from actual emissions						change in extinction from 2018 projection (environ) with CAIR				
Unit #	Facility		DSI_low	DSI_high	SDA	WFGD	WFGD_upgrade		DSI_low	DSI_high	SDA	WFGD	WFGD_upgrade
1	Big Brown	Big Brown 1	0.076	0.136	0.143	0.148	#N/A		0.039	0.100	0.107	0.112	#N/A
2	Big Brown	Big Brown 2	0.076	0.137	0.144	0.149	#N/A		0.041	0.102	0.110	0.114	#N/A
1	Coleto Creek	Coleto Creek 1	0.032	0.058	0.060	0.062	#N/A		0.033	0.059	0.061	0.062	#N/A
lim 1	Limestone	Limestone lim 1	#N/A	#N/A	#N/A	#N/A	0.052		#N/A	#N/A	#N/A	#N/A	0.064
lim 2	Limestone	Limestone lim 2	#N/A	#N/A	#N/A	#N/A	0.057		#N/A	#N/A	#N/A	#N/A	0.015
1	Martin Lake	Martin Lake 1	#N/A	#N/A	#N/A	#N/A	0.058		#N/A	#N/A	#N/A	#N/A	0.022
2	Martin Lake	Martin Lake 2	#N/A	#N/A	#N/A	#N/A	0.050		#N/A	#N/A	#N/A	#N/A	0.024
3	Martin Lake	Martin Lake 3	#N/A	#N/A	#N/A	#N/A	0.046		#N/A	#N/A	#N/A	#N/A	0.025
1	Monticello	Monticello 1	0.020	0.035	0.037	0.038	#N/A		0.023	0.039	0.041	0.041	#N/A
2	Monticello	Monticello 2	0.018	0.033	0.034	0.035	#N/A		0.026	0.040	0.042	0.043	#N/A
3	Monticello	Monticello 3	#N/A	#N/A	#N/A	#N/A	0.027		#N/A	#N/A	#N/A	#N/A	0.023
4	Sandow	Sandow 4	#N/A	#N/A	#N/A	#N/A	0.097		#N/A	#N/A	#N/A	#N/A	0.021
171b	Tolk	Tolk 171b	0.067	0.121	0.123	0.127	#N/A		0.088	0.141	0.144	0.147	#N/A
172b	Tolk	Tolk 172b	0.074	0.133	0.134	0.138	#N/A		0.067	0.126	0.127	0.132	#N/A
5	WA Parish	WA Parish 5	0.018	0.033	0.034	0.034	#N/A		-0.008	0.006	0.007	0.008	#N/A
6	WA Parish	WA Parish 6	0.020	0.035	0.037	0.037	#N/A		-0.010	0.006	0.007	0.008	#N/A
7	WA Parish	WA Parish 7	0.016	0.028	0.029	0.030	#N/A		-0.007	0.005	0.006	0.007	#N/A
8	WA Parish	WA Parish 8	#N/A	#N/A	#N/A	#N/A	0.004		#N/A	#N/A	#N/A	#N/A	0.010
1	Welsh	Welsh 1	0.009	0.015	0.016	0.017	#N/A		-0.006	-0.001	0.001	0.001	#N/A
2	Welsh	Welsh 2	0.009	0.015	0.017	0.017	#N/A		-0.007	-0.001	0.001	0.001	#N/A
3	Welsh	Welsh 3	0.010	0.016	0.017	0.018	#N/A		0.017	0.023	0.025	0.026	#N/A

Table A.6-1d. The Cumulative Average Change in Extinction levels at all other Class I areas (not WIMO, BIBE or GUMO) on W20% days for different controls

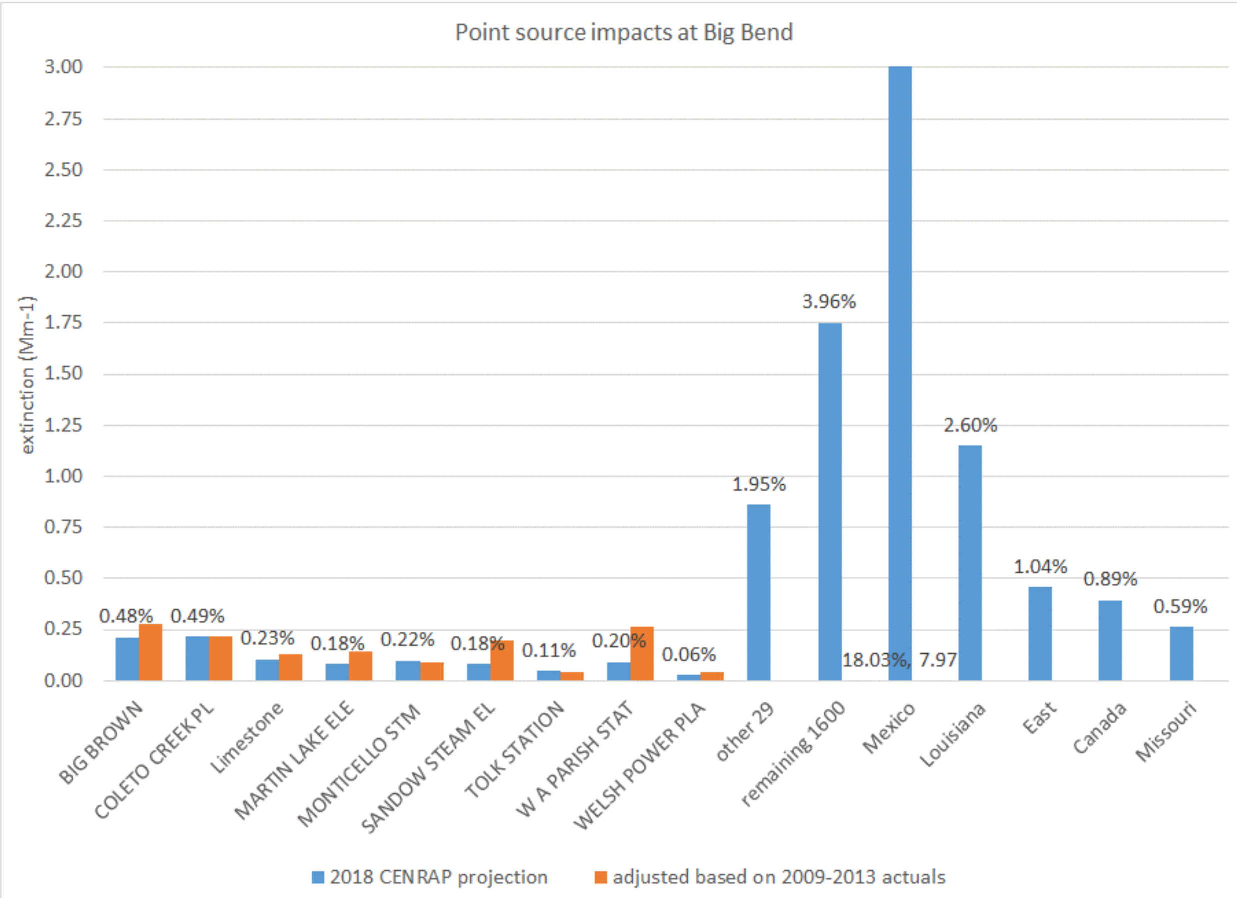
Visibility modeling results:			estimated change in extinction from actual emissions						change in extinction from 2018 projection (environ) with CAIR				
Unit #	Facility		DSI_low	DSI_high	SDA	WFGD	WFGD_upgrade		DSI_low	DSI_high	SDA	WFGD	WFGD_upgrade
1	Big Brown	Big Brown 1	0.581	1.046	1.104	1.139	#N/A		0.303	0.768	0.826	0.861	#N/A
2	Big Brown	Big Brown 2	0.584	1.051	1.109	1.143	#N/A		0.319	0.786	0.845	0.879	#N/A
1	Coleto Creek	Coleto Creek 1	0.143	0.258	0.268	0.274	#N/A		0.146	0.261	0.271	0.277	#N/A
lim 1	Limestone	Limestone lim 1	#N/A	#N/A	#N/A	#N/A	0.370		#N/A	#N/A	#N/A	#N/A	0.453
lim 2	Limestone	Limestone lim 2	#N/A	#N/A	#N/A	#N/A	0.408		#N/A	#N/A	#N/A	#N/A	0.105
1	Martin Lake	Martin Lake 1	#N/A	#N/A	#N/A	#N/A	1.676		#N/A	#N/A	#N/A	#N/A	0.624
2	Martin Lake	Martin Lake 2	#N/A	#N/A	#N/A	#N/A	1.444		#N/A	#N/A	#N/A	#N/A	0.678
3	Martin Lake	Martin Lake 3	#N/A	#N/A	#N/A	#N/A	1.321		#N/A	#N/A	#N/A	#N/A	0.721
1	Monticello	Monticello 1	0.596	1.072	1.132	1.156	#N/A		0.691	1.168	1.228	1.251	#N/A
2	Monticello	Monticello 2	0.548	0.986	1.041	1.061	#N/A		0.776	1.215	1.269	1.289	#N/A
3	Monticello	Monticello 3	#N/A	#N/A	#N/A	#N/A	0.819		#N/A	#N/A	#N/A	#N/A	0.694
4	Sandow	Sandow 4	#N/A	#N/A	#N/A	#N/A	0.465		#N/A	#N/A	#N/A	#N/A	0.101
171b	Tolk	Tolk 171b	0.313	0.563	0.573	0.591	#N/A		0.410	0.660	0.670	0.688	#N/A
172b	Tolk	Tolk 172b	0.344	0.619	0.625	0.646	#N/A		0.314	0.589	0.594	0.616	#N/A
5	WA Parish	WA Parish 5	0.181	0.326	0.335	0.344	#N/A		-0.085	0.060	0.069	0.078	#N/A
6	WA Parish	WA Parish 6	0.196	0.353	0.365	0.374	#N/A		-0.098	0.059	0.071	0.080	#N/A
7	WA Parish	WA Parish 7	0.158	0.284	0.293	0.300	#N/A		-0.073	0.054	0.062	0.070	#N/A
8	WA Parish	WA Parish 8	#N/A	#N/A	#N/A	#N/A	0.045		#N/A	#N/A	#N/A	#N/A	0.095
1	Welsh	Welsh 1	0.300	0.480	0.532	0.555	#N/A		-0.208	-0.028	0.024	0.047	#N/A
2	Welsh	Welsh 2	0.307	0.491	0.541	0.565	#N/A		-0.215	-0.031	0.019	0.044	#N/A
3	Welsh	Welsh 3	0.320	0.512	0.567	0.591	#N/A		0.558	0.750	0.805	0.829	#N/A

Figure A.6-1e. Extinction level and percent of total extinction at WIMO for W20% days for the 9 facilities assessed in second modeling effort



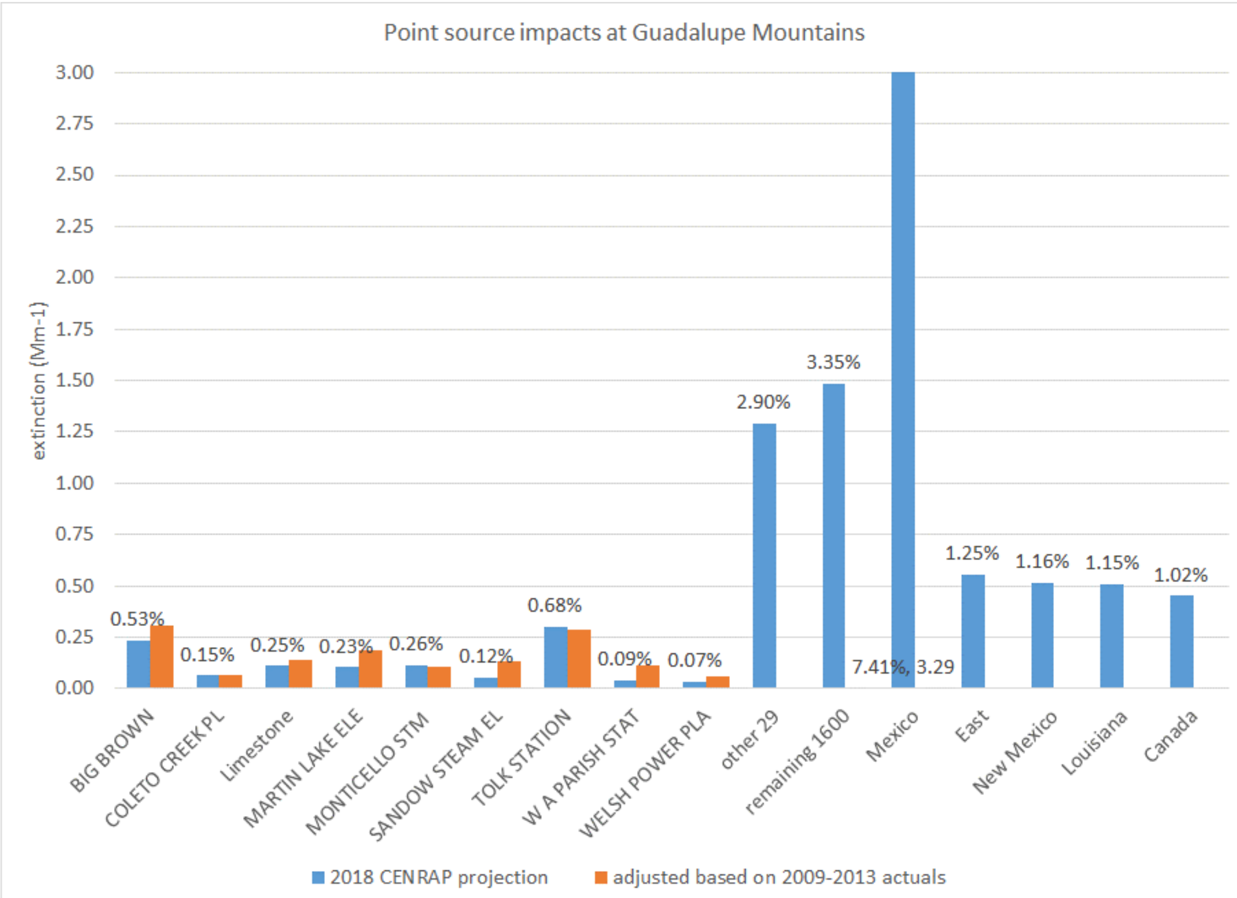
Shown in (Figure A.6-1e) are the percentage contribution to total visibility impairment due to all sources (type and category). The 2018 CENRAP projection for total extinction at WIMO is 75.56 Mm-1. Texas point sources contribute 10.58 Mm-1 (14%) to the total extinction. The blue bars on the left (ten bars on the left) are results from our initial source apportionment modeling showing the extinction due to selected facilities (9 sources and the other 29 sources). The 'remaining 1600' is actually for the 1600+ facilities originally included in our Q/D analysis minus the 38 sources we explicitly modeled. This was calculated using CENRAP 2018 data for all sources and subtracting out the 38 explicitly modeled sources. Almost all of these Texas point sources were also present in the Cenrap 2018 projection. The five bars on the far right show the impact from all point sources from the five largest contributing regions outside of Texas from the 2018 CENRAP source apportionment modeling. The orange bars show estimated extinction due to these facilities based on recent actual emissions. The recommended controls address 5.8% of total visibility impairment and 41.4% of the impact from all Texas point sources (based on 2018 CENRAP projected emission levels and our modeling of 38 Texas point source facilities).

Figure A.6-1f. Extinction level and percent of total extinction at BIBE for W20% days for the 9 facilities assessed in second modeling effort



Shown above (Figure A.6-1f) are the percent contribution to total visibility impairment due to all sources (type and category). The 2018 CENRAP projection for total extinction at BIBE is 44.23 Mm-1. Texas point sources contribute 3.56 Mm-1 (8%) to the total extinction. The blue bars on the left are results from our initial source apportionment modeling showing the extinction due to selected facilities (9 sources and the other 29 sources). The 'remaining 1600' is actually for the 1600+ facilities originally included in our Q/D analysis minus the 38 sources we explicitly modeled. Almost all of these Texas point sources were also present in the Cenrap 2018 projection. The five bars on the far right show the impact from all point sources from the five largest contributing regions outside of Texas from the 2018 CENRAP source apportionment modeling. The orange bars show estimated extinction due to these facilities based on recent actual emissions. Mexico's impacts are beyond the range of the chart. Note that the one unit at Coleto Creek has similar impacts as the two units at Big Brown. The recommended controls address 1.88% of total visibility impairment and 23.4% of impact from all Texas point sources (based on 2018 CENRAP projected emission levels). Coleto Creek accounts for over 6% of the total Texas point source impact.

Figure A.6-1g. Extinction level and percent of total extinction at GUMO for W20% days for the 9 facilities assess in second modeling effort



Shown above (Figure A.6-1g) are the percent contribution to total visibility impairment due to all sources (type and category). The 2018 CENRAP projection for total extinction at GUMO is 44.43 Mm-1. Texas point sources contribute 3.84 Mm-1 (9%) to the total extinction.The blue bars on the left are results from our initial source apportionment modeling showing the extinction due to selected facilities (9 sources and the other 29 sources). The 'remaining 1600' is actually for the 1600+ facilities originally included in our Q/D analysis minus the 38 sources we explicitly modeled. Almost all of these Texas point sources were also present in the Cenrap 2018 projection. The five bars on the far right show the impact from all point sources from the five largest contributing regions outside of Texas from the 2018 CENRAP source apportionment modeling. The orange bars show estimated extinction due to these facilities based on recent actual emissions. Mexico's impacts are beyond the range of the chart. The recommended controls address 2.22% of total visibility impairment and 25.74% of impact from all Texas point sources (based on 2018 CENRAP projected emission levels). Tolk accounts for nearly 8% of the total Texas point source impact.

The modeling results for the amount of deciview improvement from the different control levels are included in Table A.6-2a, b, and c for WIMO, BIBE and GUMO respectively. We also included Table A.6-2d which gives the same information for cumulative benefit at all the other Class I areas that were evaluated in the modeling. These tables include the deciview change based on the recent actual emissions (2009-2013) in the mid-section of the table and on the right side of the table are the change in deciviews due to differing controls based the original CENRAP 2018 projections for these units.

Table A.6-2a. Average Change in Deciview levels at WIMO on W20% days for different controls

Visibility modeling results:		dv improvement 2018 background (environ)							dv improvement (avg. natural conditions)				
Unit #	Facility		DSI_low	DSI_high	SDA	WFGD	WFGD_upgrade		DSI_low	DSI_high	SDA	WFGD	WFGD_upgrade
1	Big Brown	Big Brown 1	0.045	0.081	0.085	0.088	#N/A		0.225	0.401	0.423	0.436	#N/A
2	Big Brown	Big Brown 2	0.045	0.081	0.086	0.088	#N/A		0.226	0.403	0.425	0.438	#N/A
1	Coleto Creek	Coleto Creek 1	0.021	0.038	0.039	0.040	#N/A		0.105	0.189	0.196	0.200	#N/A
lim 1	Limestone	Limestone lim 1	#N/A	#N/A	#N/A	#N/A	0.027		#N/A	#N/A	#N/A	#N/A	0.135
lim 2	Limestone	Limestone lim 2	#N/A	#N/A	#N/A	#N/A	0.030		#N/A	#N/A	#N/A	#N/A	0.149
1	Martin Lake	Martin Lake 1	#N/A	#N/A	#N/A	#N/A	0.047		#N/A	#N/A	#N/A	#N/A	0.234
2	Martin Lake	Martin Lake 2	#N/A	#N/A	#N/A	#N/A	0.040		#N/A	#N/A	#N/A	#N/A	0.202
3	Martin Lake	Martin Lake 3	#N/A	#N/A	#N/A	#N/A	0.037		#N/A	#N/A	#N/A	#N/A	0.185
1	Monticello	Monticello 1	0.026	0.047	0.050	0.051	#N/A		0.132	0.236	0.249	0.254	#N/A
2	Monticello	Monticello 2	0.024	0.043	0.046	0.047	#N/A		0.121	0.217	0.229	0.233	#N/A
3	Monticello	Monticello 3	#N/A	#N/A	#N/A	#N/A	0.036		#N/A	#N/A	#N/A	#N/A	0.181
4	Sandow	Sandow 4	#N/A	#N/A	#N/A	#N/A	0.062		#N/A	#N/A	#N/A	#N/A	0.312
171b	Tolk	Tolk 171b	0.004	0.006	0.006	0.007	#N/A		0.018	0.032	0.033	0.034	#N/A
172b	Tolk	Tolk 172b	0.004	0.007	0.007	0.007	#N/A		0.020	0.035	0.036	0.037	#N/A
5	WA Parish	WA Parish 5	0.012	0.022	0.023	0.023	#N/A		0.062	0.111	0.114	0.117	#N/A
6	WA Parish	WA Parish 6	0.013	0.024	0.025	0.025	#N/A		0.067	0.120	0.124	0.127	#N/A
7	WA Parish	WA Parish 7	0.011	0.019	0.020	0.020	#N/A		0.054	0.097	0.099	0.102	#N/A
8	WA Parish	WA Parish 8	#N/A	#N/A	#N/A	#N/A	0.003		#N/A	#N/A	#N/A	#N/A	0.015
1	Welsh	Welsh 1	0.012	0.019	0.021	0.022	#N/A		0.059	0.094	0.105	0.109	#N/A
2	Welsh	Welsh 2	0.012	0.019	0.021	0.022	#N/A		0.060	0.096	0.106	0.111	#N/A
3	Welsh	Welsh 3	0.012	0.020	0.022	0.023	#N/A		0.063	0.101	0.111	0.116	#N/A

Table A.6-2b. Average Change in Deciview levels at BIBE on W20% days for different controls

Visibility modeling results:			dv improvement 2018 background (environ)						dv improvement (avg. natural conditions)				
Unit #	Facility		DSI_low	DSI_high	SDA	WFGD	WFGD_upgrade		DSI_low	DSI_high	SDA	WFGD	WFGD_upgrade
1	Big Brown	Big Brown 1	0.012	0.021	0.022	0.023	#N/A		0.046	0.082	0.086	0.089	#N/A
2	Big Brown	Big Brown 2	0.012	0.021	0.022	0.023	#N/A		0.046	0.082	0.087	0.089	#N/A
1	Coleto Creek	Coleto Creek 1	0.018	0.033	0.034	0.035	#N/A		0.071	0.128	0.133	0.136	#N/A
lim 1	Limestone	Limestone lim 1	#N/A	#N/A	#N/A	#N/A	0.008		#N/A	#N/A	#N/A	#N/A	0.033
lim 2	Limestone	Limestone lim 2	#N/A	#N/A	#N/A	#N/A	0.009		#N/A	#N/A	#N/A	#N/A	0.036
1	Martin Lake	Martin Lake 1	#N/A	#N/A	#N/A	#N/A	0.008		#N/A	#N/A	#N/A	#N/A	0.030
2	Martin Lake	Martin Lake 2	#N/A	#N/A	#N/A	#N/A	0.007		#N/A	#N/A	#N/A	#N/A	0.026
3	Martin Lake	Martin Lake 3	#N/A	#N/A	#N/A	#N/A	0.006		#N/A	#N/A	#N/A	#N/A	0.023
1	Monticello	Monticello 1	0.003	0.005	0.005	0.006	#N/A		0.011	0.020	0.021	0.022	#N/A
2	Monticello	Monticello 2	0.003	0.005	0.005	0.005	#N/A		0.010	0.018	0.019	0.020	#N/A
3	Monticello	Monticello 3	#N/A	#N/A	#N/A	#N/A	0.004		#N/A	#N/A	#N/A	#N/A	0.015
4	Sandow	Sandow 4	#N/A	#N/A	#N/A	#N/A	0.026		#N/A	#N/A	#N/A	#N/A	0.102
171b	Tolk	Tolk 171b	0.002	0.003	0.003	0.003	#N/A		0.007	0.012	0.013	0.013	#N/A
172b	Tolk	Tolk 172b	0.002	0.003	0.003	0.004	#N/A		0.008	0.014	0.014	0.014	#N/A
5	WA Parish	WA Parish 5	0.007	0.013	0.013	0.014	#N/A		0.028	0.051	0.052	0.054	#N/A
6	WA Parish	WA Parish 6	0.008	0.014	0.015	0.015	#N/A		0.031	0.055	0.057	0.058	#N/A
7	WA Parish	WA Parish 7	0.006	0.011	0.012	0.012	#N/A		0.025	0.044	0.046	0.047	#N/A
8	WA Parish	WA Parish 8	#N/A	#N/A	#N/A	#N/A	0.002		#N/A	#N/A	#N/A	#N/A	0.007
1	Welsh	Welsh 1	0.001	0.002	0.002	0.002	#N/A		0.005	0.008	0.008	0.009	#N/A
2	Welsh	Welsh 2	0.001	0.002	0.002	0.002	#N/A		0.005	0.008	0.009	0.009	#N/A
3	Welsh	Welsh 3	0.001	0.002	0.002	0.002	#N/A		0.005	0.008	0.009	0.009	#N/A

Table A.6-2c. Average Change in Deciview levels at GUMO on W20% days for different controls

Visibility modeling results:			dv improvement 2018 background (environ)						dv improvement (avg. natural conditions)				
Unit #	Facility		DSI_low	DSI_high	SDA	WFGD	WFGD_upgrade		DSI_low	DSI_high	SDA	WFGD	WFGD_upgrade
1	Big Brown	Big Brown 1	0.014	0.024	0.026	0.027	#N/A		0.054	0.096	0.101	0.105	#N/A
2	Big Brown	Big Brown 2	0.014	0.025	0.026	0.027	#N/A		0.054	0.097	0.102	0.105	#N/A
1	Coleto Creek	Coleto Creek 1	0.006	0.010	0.011	0.011	#N/A		0.023	0.041	0.043	0.044	#N/A
lim 1	Limestone	Limestone lim 1	#N/A	#N/A	#N/A	#N/A	0.009		#N/A	#N/A	#N/A	#N/A	0.037
lim 2	Limestone	Limestone lim 2	#N/A	#N/A	#N/A	#N/A	0.010		#N/A	#N/A	#N/A	#N/A	0.041
1	Martin Lake	Martin Lake 1	#N/A	#N/A	#N/A	#N/A	0.010		#N/A	#N/A	#N/A	#N/A	0.041
2	Martin Lake	Martin Lake 2	#N/A	#N/A	#N/A	#N/A	0.009		#N/A	#N/A	#N/A	#N/A	0.036
3	Martin Lake	Martin Lake 3	#N/A	#N/A	#N/A	#N/A	0.008		#N/A	#N/A	#N/A	#N/A	0.033
1	Monticello	Monticello 1	0.004	0.006	0.007	0.007	#N/A		0.014	0.025	0.027	0.027	#N/A
2	Monticello	Monticello 2	0.003	0.006	0.006	0.006	#N/A		0.013	0.023	0.024	0.025	#N/A
3	Monticello	Monticello 3	#N/A	#N/A	#N/A	#N/A	0.005		#N/A	#N/A	#N/A	#N/A	0.019
4	Sandow	Sandow 4	#N/A	#N/A	#N/A	#N/A	0.017		#N/A	#N/A	#N/A	#N/A	0.069
171b	Tolk	Tolk 171b	0.012	0.022	0.022	0.023	#N/A		0.048	0.085	0.087	0.090	#N/A
172b	Tolk	Tolk 172b	0.013	0.024	0.024	0.025	#N/A		0.052	0.094	0.095	0.098	#N/A
5	WA Parish	WA Parish 5	0.003	0.006	0.006	0.006	#N/A		0.013	0.023	0.024	0.024	#N/A
6	WA Parish	WA Parish 6	0.004	0.006	0.007	0.007	#N/A		0.014	0.025	0.026	0.027	#N/A
7	WA Parish	WA Parish 7	0.003	0.005	0.005	0.005	#N/A		0.011	0.020	0.021	0.021	#N/A
8	WA Parish	WA Parish 8	#N/A	#N/A	#N/A	#N/A	0.001		#N/A	#N/A	#N/A	#N/A	0.003
1	Welsh	Welsh 1	0.002	0.003	0.003	0.003	#N/A		0.007	0.011	0.012	0.012	#N/A
2	Welsh	Welsh 2	0.002	0.003	0.003	0.003	#N/A		0.007	0.011	0.012	0.012	#N/A
3	Welsh	Welsh 3	0.002	0.003	0.003	0.003	#N/A		0.007	0.011	0.012	0.013	#N/A

Table A.6-2d. The Cumulative Average Change in Deciview levels at all other Class I areas (not WIMO, BIBE or GUMO) on W20% days for different controls

Visibility modeling results:			dv improvement 2018 background (environ)						dv improvement (avg. natural conditions)				
Unit #	Facility		DSI_low	DSI_high	SDA	WFGD	WFGD_upgrade		DSI_low	DSI_high	SDA	WFGD	WFGD_upgrade
1	Big Brown	Big Brown 1	0.073	0.131	0.138	0.143	#N/A		0.308	0.553	0.584	0.602	#N/A
2	Big Brown	Big Brown 2	0.073	0.132	0.139	0.143	#N/A		0.309	0.556	0.586	0.604	#N/A
1	Coleto Creek	Coleto Creek 1	0.026	0.047	0.049	0.050	#N/A		0.092	0.165	0.171	0.175	#N/A
lim 1	Limestone	Limestone lim 1	#N/A	#N/A	#N/A	#N/A	0.046		#N/A	#N/A	#N/A	#N/A	0.197
lim 2	Limestone	Limestone lim 2	#N/A	#N/A	#N/A	#N/A	0.051		#N/A	#N/A	#N/A	#N/A	0.218
1	Martin Lake	Martin Lake 1	#N/A	#N/A	#N/A	#N/A	0.173		#N/A	#N/A	#N/A	#N/A	0.800
2	Martin Lake	Martin Lake 2	#N/A	#N/A	#N/A	#N/A	0.149		#N/A	#N/A	#N/A	#N/A	0.691
3	Martin Lake	Martin Lake 3	#N/A	#N/A	#N/A	#N/A	0.137		#N/A	#N/A	#N/A	#N/A	0.632
1	Monticello	Monticello 1	0.063	0.114	0.120	0.123	#N/A		0.290	0.520	0.549	0.561	#N/A
2	Monticello	Monticello 2	0.058	0.105	0.111	0.113	#N/A		0.267	0.479	0.505	0.515	#N/A
3	Monticello	Monticello 3	#N/A	#N/A	#N/A	#N/A	0.087		#N/A	#N/A	#N/A	#N/A	0.398
4	Sandow	Sandow 4	#N/A	#N/A	#N/A	#N/A	0.074		#N/A	#N/A	#N/A	#N/A	0.277
171b	Tolk	Tolk 171b	0.066	0.119	0.121	0.125	#N/A		0.214	0.385	0.392	0.404	#N/A
172b	Tolk	Tolk 172b	0.073	0.131	0.132	0.137	#N/A		0.236	0.424	0.427	0.442	#N/A
5	WA Parish	WA Parish 5	0.024	0.044	0.045	0.046	#N/A		0.098	0.176	0.181	0.186	#N/A
6	WA Parish	WA Parish 6	0.026	0.047	0.049	0.050	#N/A		0.106	0.191	0.197	0.202	#N/A
7	WA Parish	WA Parish 7	0.021	0.038	0.039	0.040	#N/A		0.085	0.154	0.158	0.162	#N/A
8	WA Parish	WA Parish 8	#N/A	#N/A	#N/A	#N/A	0.006		#N/A	#N/A	#N/A	#N/A	0.024
1	Welsh	Welsh 1	0.032	0.051	0.056	0.058	#N/A		0.146	0.233	0.258	0.269	#N/A
2	Welsh	Welsh 2	0.032	0.052	0.057	0.059	#N/A		0.149	0.238	0.263	0.274	#N/A
3	Welsh	Welsh 3	0.034	0.054	0.060	0.062	#N/A		0.155	0.248	0.275	0.287	#N/A

We also evaluated the deciview change for both a "dirty background" (2018 analysis) and a "clean background," the latter also referred to as Natural Conditions (NC) based on the estimated average annual natural conditions.[50] Building on our previous "clean vs. dirty" discussion above, one way to view these two situations is that the deciview change for the 2018 model projections (dirty background) is the minimum level of deciview improvement that will be achieved from the controls and the NC (clean background) is the upper end of the deciview benefit from controls. These two values provide the range in visibility benefit that will result from any reduction in emissions due to the range of controls we considered.

Of the 21 units evaluated, eight had existing scrubbers, so the main control evaluated for these eight facilities was upgrading the scrubber control to 95% level controls (see above in this TSD and also our Cost TSD for further information). Table A.6-3 includes the amount of SO_2 emission reductions and the amount of deciview improvement due to scrubber upgrades on these eight units. The deciview improvements are reported for both the 2018 (dirty background) and the average NCs. This includes information for the thee Class I areas and also the cumulative of the 19 Class I areas (WIMO, GUMO, BIBE and 16 other Class I areas).

Table A.6-4 shows the deciview improvements from the different control scenarios evaluated for each unit not already equipped with SO_2 controls. This includes benefits for installing Dry Sorbent Injection (DSI) with a high and low control level, SDA and wet FGD. Overall DSI (with 40-60% control) achieves substantially less visibility and extinction improvement then either SDA or wet FGD scrubbers. We weigh this significant difference in visibility benefit when we consider if and what controls are reasonable in our cost/benefit analysis.

[50] NC II, or new IMPROVE natural visibility conditions are available at: http://vista.cira.colostate.edu/Docs/IMPROVE/Aerosol/NaturalConditions/NaturalConditionsII_Format2_v2.xls

Table A.6-3. Deciview improvement at Class I areas for scrubber upgrades

Emission Unit	Control (%)	SO_2 Reduction (tpy)	Estimated deciview improvement from actual emissions (3-yr average annual tpy2009-2013 eliminating min and max yr)										
			WIMO		BIBE		GUMO		Cumulative (19 areas)		highest remaining		
			2018	avg. NC	2018	avg. NC	2018	avg. NC	2018	avg. NC	2018	avg. NC	Class I area
Limestone lim 1	95	8,446	0.027	0.135	0.008	0.033	0.009	0.037	0.091	0.401	0.014	0.070	CACR
Limestone lim 2	95	9,331	0.030	0.149	0.009	0.036	0.010	0.041	0.100	0.443	0.015	0.077	CACR
Martin Lake 1	95	20,789	0.047	0.234	0.008	0.030	0.010	0.041	0.238	1.105	0.089	0.441	CACR
Martin Lake 2	95	17,917	0.040	0.202	0.007	0.026	0.009	0.036	0.205	0.954	0.077	0.381	CACR
Martin Lake 3	95	16,389	0.037	0.185	0.006	0.023	0.008	0.033	0.188	0.873	0.070	0.349	CACR
Monticello 3	95	12,286	0.036	0.181	0.004	0.015	0.005	0.019	0.132	0.614	0.037	0.188	CACR
Sandow 4	95	17,664	0.062	0.312	0.026	0.102	0.017	0.069	0.180	0.759	0.017	0.069	CAVE
WA Parish 8	95	1,750	0.003	0.015	0.002	0.007	0.001	0.003	0.012	0.050	0.001	0.007	CACR

Table A.6-4. Deciview Improvent due to differing levels of control on existing uncontrolled units

				Estimated deciview improvement from actual emissions (3-yr average annual tpy2009-2013 eliminating min and max yr)										
				WIMO		BIBE		GUMO		Cumulative (19 areas)		highest remaining		
Emission Unit	Control (%)	Control	SO_2 Reduction (tpy)	dv improvement 2018 background	dv improvement (avg. natural conditions background)	dv improvement 2018 background	dv improvement (avg. natural conditions background)	dv improvement 2018 background	dv improvement (avg. natural conditions background)	dv improvement 2018 background	dv improvement (avg. natural conditions background)	dv improvement 2018 background	dv improvement (avg. natural conditions background)	Class I area
Big Brown 1	50	DSI	15,334	0.045	0.225	0.012	0.046	0.014	0.054	0.143	0.632	0.018	0.092	CACR
	90	DSI	27,600	0.081	0.401	0.021	0.082	0.024	0.096	0.257	1.132	0.033	0.164	CACR
	95	SDA	29,134	0.085	0.423	0.022	0.086	0.026	0.101	0.272	1.194	0.035	0.173	CACR
	98	WFGD	30,054	0.088	0.436	0.023	0.089	0.027	0.105	0.280	1.232	0.036	0.179	CACR
Big Brown 2	50	DSI	15,407	0.045	0.226	0.012	0.046	0.014	0.054	0.143	0.635	0.018	0.092	CACR
	90	DSI	27,733	0.081	0.403	0.021	0.082	0.025	0.097	0.258	1.137	0.033	0.165	CACR
	95	SDA	29,273	0.086	0.425	0.022	0.087	0.026	0.102	0.273	1.200	0.035	0.174	CACR
	97.9	WFGD	30,169	0.088	0.438	0.023	0.089	0.027	0.105	0.281	1.236	0.036	0.179	CACR
Coleto Creek	50	DSI	8,030	0.021	0.105	0.018	0.071	0.006	0.023	0.071	0.291	0.006	0.023	CAVE
	90	DSI	14,453	0.038	0.189	0.033	0.128	0.010	0.041	0.128	0.523	0.010	0.041	CAVE
	93.5	SDA	15,012	0.039	0.196	0.034	0.133	0.011	0.043	0.133	0.543	0.011	0.043	CAVE
	95.7	WFGD	15,361	0.040	0.200	0.035	0.136	0.011	0.044	0.136	0.555	0.011	0.044	CAVE
Monticello 1	50	DSI	8,933	0.026	0.132	0.003	0.011	0.004	0.014	0.096	0.447	0.027	0.137	CACR
	90	DSI	16,079	0.047	0.236	0.005	0.020	0.006	0.025	0.173	0.802	0.049	0.245	CACR
	95	SDA	16,972	0.050	0.249	0.005	0.021	0.007	0.027	0.182	0.846	0.052	0.258	CACR
	97	WFGD	17,328	0.051	0.254	0.006	0.022	0.007	0.027	0.186	0.863	0.053	0.264	CACR
Monticello 2	50	DSI	8,215	0.024	0.121	0.003	0.010	0.003	0.013	0.088	0.411	0.025	0.126	CACR
	90	DSI	14,786	0.043	0.217	0.005	0.018	0.006	0.023	0.159	0.738	0.045	0.226	CACR
	95	SDA	15,608	0.046	0.229	0.005	0.019	0.006	0.024	0.168	0.778	0.048	0.238	CACR
	96.8	WFGD	15,907	0.047	0.233	0.005	0.020	0.006	0.025	0.171	0.793	0.048	0.242	CACR
Tolk 171B	50	DSI	5,016	0.004	0.018	0.002	0.007	0.012	0.048	0.083	0.286	0.017	0.060	SACR
	90	DSI	9,028	0.006	0.032	0.003	0.012	0.022	0.085	0.150	0.515	0.030	0.108	SACR
	91.7	SDA	9195	0.006	0.033	0.003	0.013	0.022	0.087	0.153	0.524	0.031	0.110	SACR
	94.4	WFGD	9474	0.007	0.034	0.003	0.013	0.023	0.090	0.158	0.540	0.032	0.113	SACR
Tolk 172B	50	DSI	5,517	0.004	0.020	0.002	0.008	0.013	0.052	0.092	0.315	0.018	0.066	SACR
	90	DSI	9,931	0.007	0.035	0.003	0.014	0.024	0.094	0.165	0.566	0.033	0.119	SACR
	90.8	SDA	10015	0.007	0.036	0.003	0.014	0.024	0.095	0.167	0.571	0.034	0.120	SACR
	93.8	WFGD	10355	0.007	0.037	0.004	0.014	0.025	0.098	0.172	0.590	0.035	0.124	SACR
WA Parish 5	50	DSI	7,079	0.012	0.062	0.007	0.028	0.003	0.013	0.047	0.201	0.006	0.030	CACR
	90	DSI	12,741	0.022	0.111	0.013	0.051	0.006	0.023	0.084	0.361	0.011	0.054	CACR
	92.5	SDA	13095	0.023	0.114	0.013	0.052	0.006	0.024	0.087	0.371	0.011	0.055	CACR
	95	WFGD	13449	0.023	0.117	0.014	0.054	0.006	0.024	0.089	0.381	0.011	0.057	CACR
WA Parish 6	50	DSI	7,654	0.013	0.067	0.008	0.031	0.004	0.014	0.051	0.217	0.006	0.032	CACR
	90	DSI	13,776	0.024	0.120	0.014	0.055	0.006	0.025	0.091	0.390	0.011	0.058	CACR
	93.1	SDA	14251	0.025	0.124	0.015	0.057	0.007	0.026	0.095	0.404	0.012	0.060	CACR
	95.4	WFGD	14603	0.025	0.127	0.015	0.058	0.007	0.027	0.097	0.414	0.012	0.061	CACR
WA Parish 7	50	DSI	6,168	0.011	0.054	0.006	0.025	0.003	0.011	0.041	0.175	0.005	0.026	CACR
	90	DSI	11,102	0.019	0.097	0.011	0.044	0.005	0.020	0.074	0.315	0.009	0.047	CACR
	92.7	SDA	11432	0.020	0.099	0.012	0.046	0.005	0.021	0.076	0.324	0.010	0.048	CACR
	95.1	WFGD	11733	0.020	0.102	0.012	0.047	0.005	0.021	0.078	0.333	0.010	0.049	CACR
Welsh 1	50	DSI	4,042	0.012	0.059	0.001	0.005	0.002	0.007	0.046	0.216	0.015	0.074	CACR
	80	DSI	6,467	0.019	0.094	0.002	0.008	0.003	0.011	0.074	0.346	0.024	0.119	CACR
	88.7	SDA	7169	0.021	0.105	0.002	0.008	0.003	0.012	0.082	0.383	0.026	0.132	CACR
	92.5	WFGD	7474	0.022	0.109	0.002	0.009	0.003	0.012	0.085	0.399	0.027	0.137	CACR
Welsh 2	50	DSI	4,128	0.012	0.060	0.001	0.005	0.002	0.007	0.047	0.221	0.015	0.076	CACR
	80	DSI	6,605	0.019	0.096	0.002	0.008	0.003	0.011	0.075	0.353	0.024	0.121	CACR
	88.2	SDA	7285	0.021	0.106	0.002	0.009	0.003	0.012	0.083	0.389	0.027	0.134	CACR
	92.2	WFGD	7608	0.022	0.111	0.002	0.009	0.003	0.012	0.087	0.406	0.028	0.140	CACR
Welsh 3	50	DSI	4,305	0.012	0.063	0.001	0.005	0.002	0.007	0.049	0.230	0.016	0.079	CACR
	80	DSI	6,887	0.020	0.101	0.002	0.008	0.003	0.011	0.079	0.368	0.025	0.126	CACR
	88.7	SDA	7634	0.022	0.111	0.002	0.009	0.003	0.012	0.087	0.408	0.028	0.140	CACR
	92.5	WFGD	7959	0.023	0.116	0.002	0.009	0.003	0.013	0.091	0.425	0.029	0.146	CACR

As we have discussed above in our "RP vs. BART" section, we acknowledge that the del-deciview values (improvement in visibility) may seem small compared to BART CALPUFF based analysis impacts/metric. Also, as discussed above, there is no way to directly compare RP results with CAMx with BART analyses with CALPUFF. We have evaluated the deciview improvement for the natural conditions ("clean background") conditions which we believe helps factor in the approach that CALPUFF uses in the sense that all CALPUFF analyses are typically performed based on a 'clean background' situation.

We have also evaluated these impacts considering the amount of extinction improvement that could be achieved due to controls and compared these values to extinction levels supported by consultation metrics, etc., and concluded that these impacts are in the ballpark of potential benefits that may have been evaluated in a consultation process between states that had the potential to result in additional controls. For example, Oklahoma invited those states projected to contribute greater than 1 inverse megameter of light extinction (from all sources in the state combined) at the Wichita Mountains in 2018 to consultations. Similarly, Texas invited states with greater than 0.5 inverse megameter impact on one of Texas' Class I areas to consult.[51]

We also evaluated recent FIPs that have included controls for RP. In our FIP for Wyoming, we controlled some sources that had a benefit of 0.3 dv using CALPUFF[52]. Given the modeled emissions differences between RP with CAMx and BART with CALPUFF and difference in metrics it can be argued that a 0.3 dv benefit with CALPUFF would be on the order of 0.1-0.15 deciview benefit with CAMx modeling (this is an estimate just based on emissions and metrics differences and ignoring the other differences discussed above.)

We also recently finalized a FIP in Arizona that included controls that resulted in a 0.18 del-dv and 0.24 del-dv benefit based on CALPUFF modeling[53]. Again, given the modeled emissions differences between RP analysis with CAMx and BART analysis with CALPUFF and difference in metrics it can be argued that a 0.18-0.24 del-dv benefit with CALPUFF would be on the order of 0.1 del-dv or less benefit with CAMx modeling (this is an estimate just based on emissions and metrics differences and ignoring the other differences discussed above).

Weighing this information with the deciview benefit and extinction benefit on a (1/Mm) and percentage basis with the other information analyzed, we conclude that all of the scrubber upgrades in Table A.6.3 would yield visibility benefits, with the exception of WA Parish Unit 8 which has a very small benefit.

Weighing this information with the deciview benefit and extinction benefit on a (1/Mm) and percentage basis with the other information analyzed, we conclude that many of the scrubber retrofits in Table A.6.4 would yield visibility benefits. We note a decrease in visibility improvement benefits at the three Class I areas for the W. A. Parish and Welsh units compared to the benefits at other facilities that mainly impact WIMO. Tolk has a smaller deciview benefit at WIMO and controlling Tolk mainly benefits GUMO, but in assessing Tolk, we must also weigh the percent of extinction that would be achieved as well, since GUMO has a much lower overall

[51] See Appendix 4-1 of the TX RH SIP.
[52] Wyoming Final FIP FR Vol. 78, No. 111; pages 34785-,34789.
[53] Arizona Final FIP FR Vol. 79, No. 170; pages 52464-52477

extinction compared to WIMO. Coleto Creek and some of the other higher impacting sources have benefits at more than one of the three Class I areas (WIMO, BIBE, and GUMO), therefore we also consider the benefits when they occurred at two or three Class I areas in determining whether the visibility improvements are potentially worth achieving if we determined that cost effective controls are available.

Table A.6-5 Includes the net benefit on the proposed control level proposed in Section 6 on the projected visibility conditions based on reducing actual emission levels.

Table A.6-5. Net benefit of proposed controls on 2018 Visibility projections

Estimated deciview improvement (avg 20% Worst days) from actual emissions (3-yr average annual tpy 2009-2013 eliminating min and max yr)						
	Wichita Mtns.		Big Bend		Guadalupe Mtn. [1]	
	2018 'dirty' background	Avg. natural conditions 'clean' background	2018 'dirty' background	Avg. natural conditions 'clean' background	2018 'dirty' background	Avg. natural conditions 'clean' background
Total Visibility Recommended Scrubber Retrofits	0.331	1.629	0.098	0.382 (Coleto Creek 1-0.133)	0.124	0.487 (Tolk 1&2 – 0.187)
Total Visibility Recommended Scrubber Upgrades	0.281	1.396	0.068	0.265	0.070	0.275
Total Benefit (delta dv)	**0.622**	**3.03**	**0.167**	**0.646**	**0.195**	**0.763**

We note that current actual emissions for many of the units that we propose to control are higher than the projected CENRAP 2018 emission rate. Therefore, the actual visibility impact due to emissions from these sources and the anticipated benefit from controls are larger than the benefits calculated based on the 2018 CENRAP projected visibility conditions.

Table A.6-6 Includes the net benefit on the proposed controls proposed in Section 6 on the 2018 projected visibility conditions based on reducing emission levels from the projected 2018 CENRAP levels.

Table A.6-6. Predicted benefit of all proposed controls beyond 2018 CENRAP projected visibility conditions (2018 'dirty' background)

	Predicted additional benefit due only to FIP scrubber upgrades (dv)	Additional benefit predicted due to FIP scrubber retrofits (dv)	Total benefit from proposed controls
Wichita Mountains	0.14	0.30	0.45
Big Bend	0.03	0.09	0.12
Guadalupe Mountains	0.04	0.12	0.15